High Performance Multifunction Programmable

Two-Axis/Four-Axis Stage Controller

SHOT-302GS
SHOT-304GS

—Stepping motor stage/GS Stage—

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For Your Safety

- Before using this product, read this manual and all warnings or cautions in the documentation provided.
- Only Factory Authorized Personnel should be changes and/or adjust the parts of controller.

The Symbols Used in This Manual

⚠ WARNING	⚠ CAUTION
This symbol marks warnings that should be read and used to prevent serious injury or death.	This symbol indicates where caution should be used to avoid possible injury to yourself or others, or damage to property.

The above indications are used together with the following symbols to indicate the exact nature of the warning or caution.

Examples of Symbols Accompanying Warnings and Cautions	
	△ Symbols enclosed in a triangle indicate warnings and cautions. The exact nature of the warning or caution is indicated by the symbol inside (the symbol at left indicates risk of electrocution).
	○ Symbols enclosed in a circle mark indicate prohibitions (actions that must not be performed). The exact nature of the prohibition is indicates by the symbol inside or next to the circle mark (the symbol at left indicates that the product must not be disassembled).
	● Symbols inside a black circle mark actions that must be performed to ensure safety. The exact nature of the action that must be performed is indicated by the symbol inside (the symbol at left is used in cases in which the AC adapter must be unplugged to ensure safety).

Symbols on the product

The symbol mark on the product calls your attention. Please refer to the manual, in the case that you operate the part of the symbol mark on the product.

	This symbol labeled on the portion calls your attention.

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① SIGMAKOKI CO., LTD. does not accept liability for damages resulting from the use of this product or the inability to use this product.
② SIGMAKOKI CO., LTD. does not accept liability for damages resulting from the use of this product that deviates from that described in the manual.
③ SIGMAKOKI CO., LTD. does not accept liability for damages resulting from the use of this product in extraordinary conditions, including fire, earthquakes, and other acts of God, action by any third party, other accidents, and deliberate or accidental misuse.
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⚠ WARNING

- Do not use this product in the presence of flammable gas, explosives, or corrosive substances, in areas exposed to high levels of moisture or humidity, in poorly ventilated areas, or near flammable materials.
- Do not connect or check the product while the power is on.
- Installation and connection should be performed only by a qualified technician.
- Do not bend, pull, damage, or modify the power or connecting cables.
- Do not touch the products internal parts.
- Connect the earth terminal to ground.
- Should the product overheat, or should you notice an unusual smell, heat, or unusual noises coming from the product, turn off the power immediately.
- Do not turn on the power in the event that it has received a strong physical shock as the result of a fall or other accident.
- Do not touch the stage while operation.
- Use dry clothes only for cleaning the equipment.

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Chapter 1: Before You Begin

1. Package Contents

Purchasers of the Stage Controller should find that the package contains the items listed below. Check the package contents using the following checklist. Contact your retailer as soon as possible in the event that you should find that any item is missing or damaged.

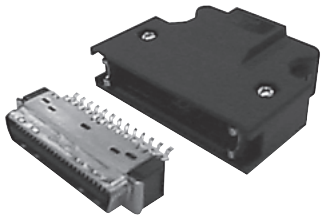
You can download sample programs from our web page.
For the details of the samples, see the manual of each program.
View our home page http://www.sigma-koki.com

☐ **Stage Controller**

☐ **Manual**

☐ **2.3meter AC power cable**

I/O signal connector
(option)



(product number 10150 or 10350, equivalent Sumitomo 3M product)

Control pad CJ-200/CJ-200A
(option)

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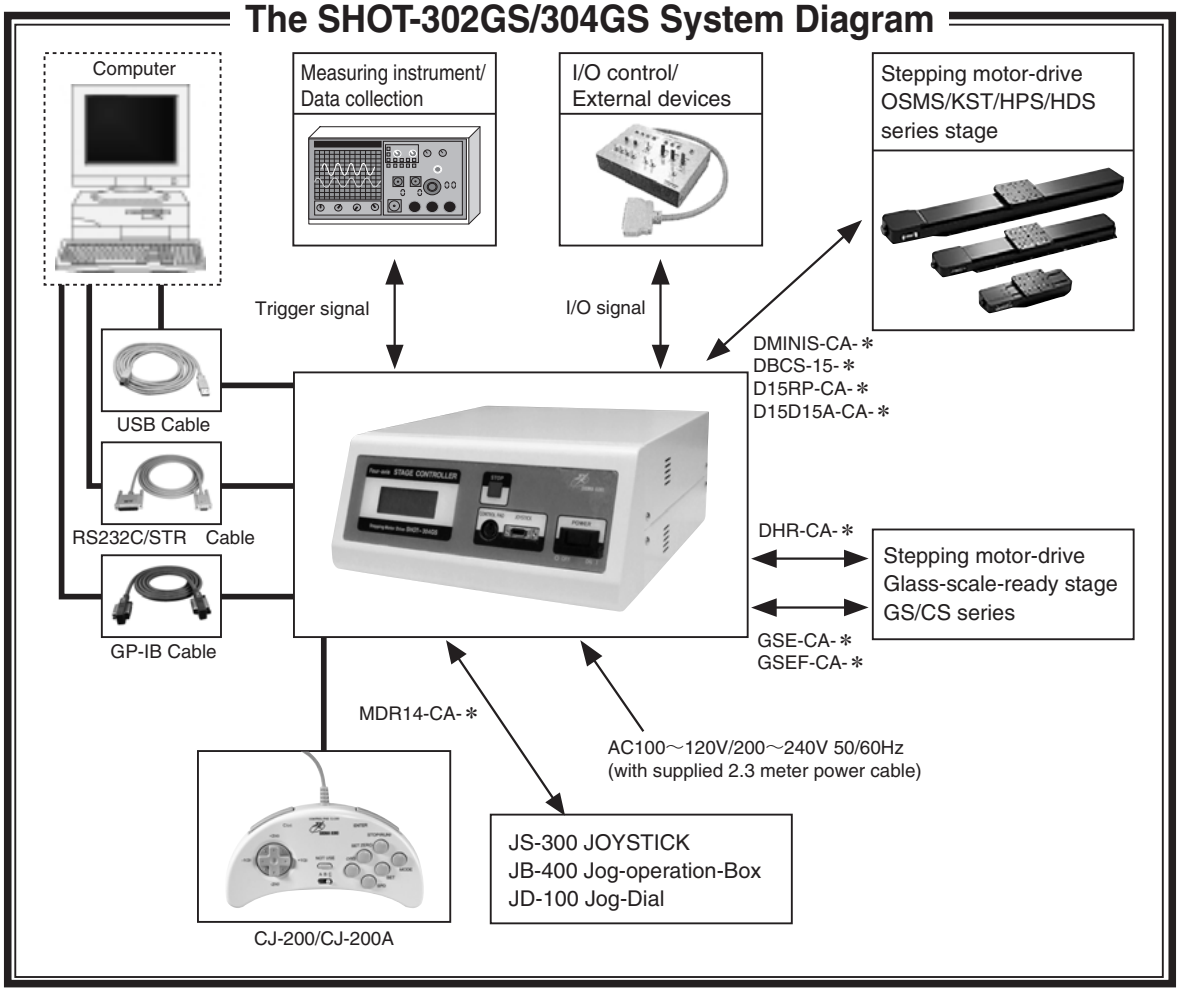
2. Overview

The SHOT-302GS is a glass-scale-ready, two-axis stage controller for full-closed loop control.
The SHOT-304GS is a glass-scale-ready, four-axis stage controller for full-closed loop control.
Compatible with existing models, this controller offers excellent applicability across a wide range of requirements at a low cost.
When the SHOT-302GS/304GS is connected to an ordinary personal computer via an RS232C, GP-IB or USB interface, the stage can be accurately moved to the desired position by simple commands sent from the PC. Also, it is possible to save internal data via program data downloads and uploads. The program has been simplified for ease of construction of complicated control systems. Internal power supply for I/O (Input/Output) signals, trigger output signals, and DC24V output signals makes it possible to control external input or output devices or to output trigger signals synchronized with external measuring devices.

3. The SHOT-302GS/304GS System



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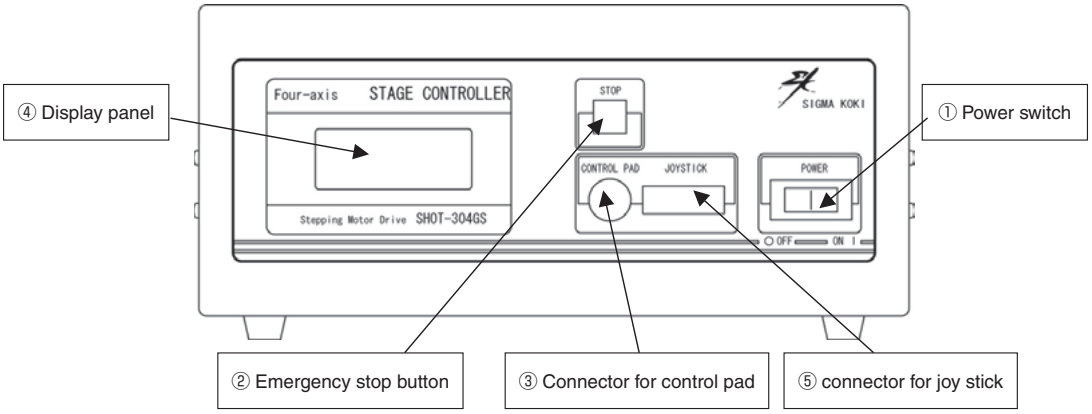
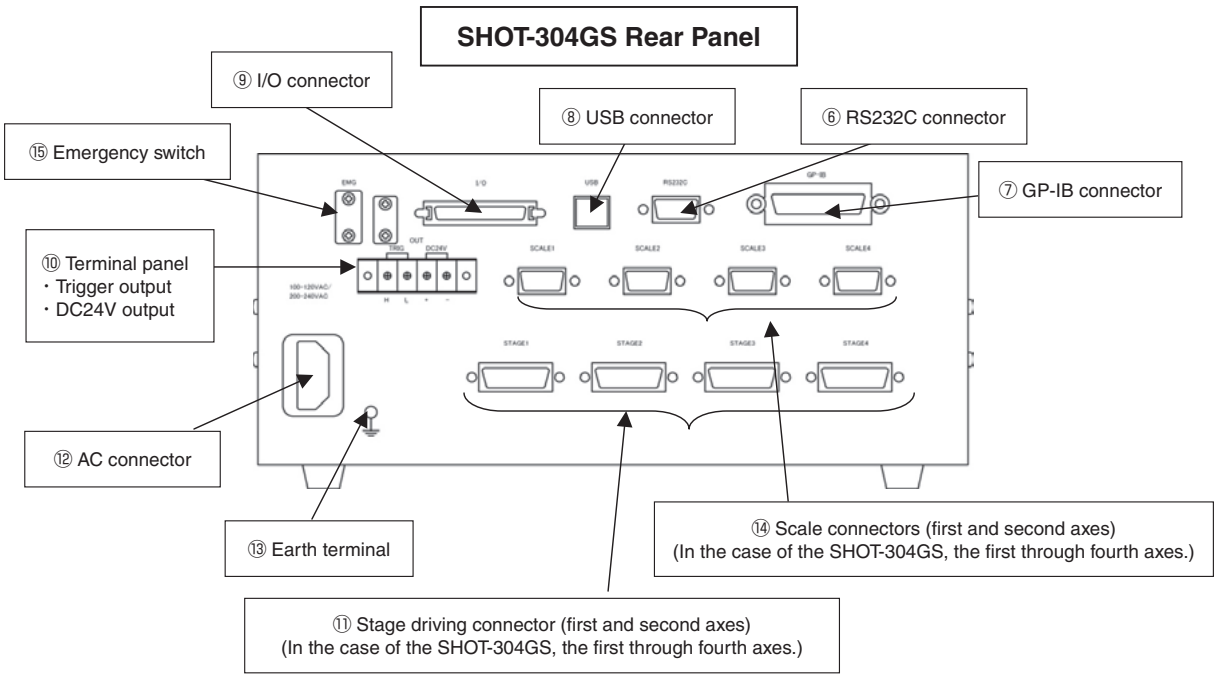
4. Parts of the SHOT-302GS and 304GS

SHOT-304GS Front Panel



SHOT-304GS Rear Panel



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Functions

① The product is on when the switch is set to ON. Set the switch to OFF to turn the product off.

② Press this button to stop immediately any motorized stages currently in progress.

③ This is where a control pad for button control is connected the CJ-200/CJ-200A may be used.
The pad can be used to drive the motorized stage through button controls or the controls for each operating mode.

④ Displays the position coordinates for each axis and the operating mode.

⑤ This connector is used when the JS-300 or JB-400/JD-100.

⑥ This connector is used when the device is controlled from the computer via an RS232C interface.

⑦ This connector is used when the device is controlled from the computer via a GP-IB interface.

⑧ This connector is used when the device is controlled from the computer via a USB interface.

⑨ The connector accepts a cable for sending and receiving I/O and control signals to/from an external device. It can also be used to drive motorized stages remotely or to start programmed operations.

⑩ The terminal panel is used when you use trigger output signals or the DC24V power source.

⑪ Connect to the motorized stage of your choice. Supports up to four axes.

⑫ This is where you connect the supplied 2.3meter power cable.

● USABLE DETACHBLE POWER CORDS

Type	Connecter	Cord	Attachment plug cap
SHOT-302GS/304GS AC100-120V	Use the detachable power cord set attached to the product only.		
SHOT-302GS/304GS AC200-240V	IEC C-22 Rated 7A, 250V UL, CSA Approved	Type SJT, No16 AWG Min. 3-Conductors (Single phased; 2-current carrying & ground) UL, CSA Approved	NEMA6-15P Tandem blade Rated 7A, 250V UL, CSA Approved

Cable length of above Power Supply cord shall be shorter than 4.5m.

⑬ Ground the equipment when in use.

⑭ Connects to the glass-scales to be used. Supports up four axes.

⑮ Press this switch to stop immediately any motorized stages currently in progress.

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Chapter 2: Basic Operations

The basic operations needed to position motorized stages are outlined below, with cross-references to the sections of the manual in which these operations are described in detail. Mastering these operations will acquaint you with SHOT-302GS/304GS controllers and their operation.

5. Connecting to Motorized stages

Connect each glass-scale-specification motorized stage to the respective connector (first through fourth axes) via the dedicated cable. Adjust the driver switch settings for each of the connected motorized stages.

[See] 5-1 Connecting to Motorized Stages ☞ Page 11
5-2 Connecting Power Cable with Control Pad, joy stick ☞ Page 11
5-3 Setting Driver Switch Settings ☞ Page 12

6. Turning the Controller on

Turn on the power switch on the front panel
The version number will be displayed in the LCD panel, followed by the initialization screen. Adjust the memory switch settings for each of the connected motorized stages.

[See] 6-1 Operation Mode at Power On ☞ Page 13
6-2 Changing the Operation Mode at Power On ☞ Page 14
6-3 Checking Memory Switch Settings ☞ Page 15

7. Changing the Operation Mode with the Control Pad

Press the MODE button on the control pad to cycle the controller through the available operating modes in the following order (press MODE while holding down the Ctrl key to cycle through mode settings in the reverse order):

HOST(COMPUTER)→ MANUAL → REMOTE(EXECUTE)→ TEACHING (PROGRAM)→ EDIT → LOAD → TEST → HOST(COMPUTER)→ …

[See] 7-1 The Control Pad ☞ Page 16
7-2 Operating Modes and Control Buttons ☞ Page 17

8. Using the Control Pad and the joystick to Position Motorized Stages

Manual mode (MANUAL: M) operation

You can move motorized stages in different directions using the cross-shaped
button on the control pad. The remaining six buttons can be used to change speed or return the stage to its mechanical or logical origin.

[See] 8-1 Using the Control Pad and the joy stick to Control Motorized Stages ☞ Page 18

9. Changing the Memory Switch

Manual mode (MANUAL: M) operation

Parameter settings for driving each of the motorized stages, including settings for speed, data transfer, and display, can be stored in memory switches.
The data stored in the memory switches can be confirmed or changed either by pressing the Ctrl and SET buttons on the control pad or using computer commands.

[See] 9-1 Changing Memory-Switch Settings ☞ Page 19
9-2 Setting Memory Switches: An Example ☞ Page 19
9-3 Memory Switch Settings for the SHOT-302GS/304GS ☞ Page 21
9-4 Memory Switch Settings in Detail ☞ Page 23

10. Using a Computer to Position Motorized Stages

Host (computer) mode (HOST: H) operation

Motorized stages can be controlled by sending simple commands from the computer to the stage controller (e.g., Speed D command/parallel move M command/driver G command).

[See] 10-1 Control Pad Operations ☞ Page 30
10-2 List of Commands ☞ Page 30
10-3 Command Format ☞ Page 32
10-4 Commands in Detail ☞ Page 32

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5. Connecting to Motorized Stages

The controllers can be connected to a variety of different motorized stages on from one to four axes using dedicated cables.

5-1 Connecting to Motorized Stages

First, connect the Controller to the motorized stages.

Here is an example of how to connect the motorized stages BIOS-209T to the SHOT-304GS controller.

<Connecting the cable for the motorized stages to the controller. >

Example) ① Connect a standard cable (DHR-CA) to the connector (round-type 12P: male) of the motorized stage BIOS-209T-X axis.
② Connect a standard cable (DHR-CA) to the connector (round-type 12P: male) of the motorized stage BIOS-209T-Y axis.
③ Connect the cable from the BIOS-209T-X axis to the D-sub 15-pin female STAGE 1 connector on the rear panel of the SHOT-304GS controller.
④ Connect the cable from the BIOS-209T-Y axis to the D-sub 15-pin female STAGE 2 connector on the rear panel of the SHOT-304GS controller.
⑤ Connect the cable (GSE-CA-*) for scales to the connector (D-sub15P) of the motorized stage BIOS-209T-X axis.
⑥ Connect the cable (GSE-CA-*) for scales to the connector (D-sub15P) of the motorized stage BIOS-209T-Y axis.
⑦ Connect the cable of the BIOS-209T-X axis to the SCALE 1 connectors (D-sub15P) on the rear panel of the SHOT-304GS controller.
⑧ Connect the cable of the BIOS-209T-Y axis to the SCALE 2 connectors (D-sub15P) on the rear panel of the SHOT-304GS controller.

5-2 Connecting Power Cable with Control Pad

Connect the supplied power cable to the AC connector on the rear panel of the controller to plug the cable into an outlet. (Ensure that it is grounded.)

To use the control pad CJ-200/CJ-200A with the stage controller, insert the connector (male) with its arrow mark upward into "CONTROL PAD" in the center of the front panel.

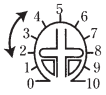
5-3 Setting the driver switches

Adjust the driver switch located on the bottom of the controller for each of the connected motorized stages. (☞For details, see Section 19 “Driver Switch Settings.”)

5-3-1 Setting the drive current (digital switch RUN)

Set the current for running motors by adjusting the position of the rotary volume RUN according to the following table. The required driving current depends on the stage to be used. Make the settings according to the rated current value (specified on a side of the stage).

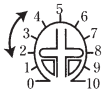
SW No.	0	1	2	3	4	5	6	7	8	9	10
Current value (A)	0.25	0.27	0.32	0.5	0.66	0.75	0.86	1	1.1	1.25	1.4



5-3-2 Setting the stop current (digital switch STOP)

Set the current for motors at rest by adjusting the position of the rotary volume STOP according to the following table. Each figure in this table indicates a percentage of the drive (RUN) current value you set. The stop current is factory-set to 5 (50%).

SW No.	0	1	2	3	4	5	6	7	8	9	10
%	20	24	27	37	41	51	60	68	75	80	88



《RUN and STOP setting examples》

Example	RUN	STOP
STAGE1 OSMS20-85	5 (0.75A)	5 (51%)

Settings for Stages 1

RUN ：Set the driving current to 0.75A (from motor).

STOP：Set the stop current to 51 % of the drive current.

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6. Turning the Stage Controller On

The controllers can be connected to variety of different motorized stages on from one to four axes using dedicated cables. Example are shown in figures 6-1 and 6-2.

Fig. 6-1 SHOT-302GS LCD Display

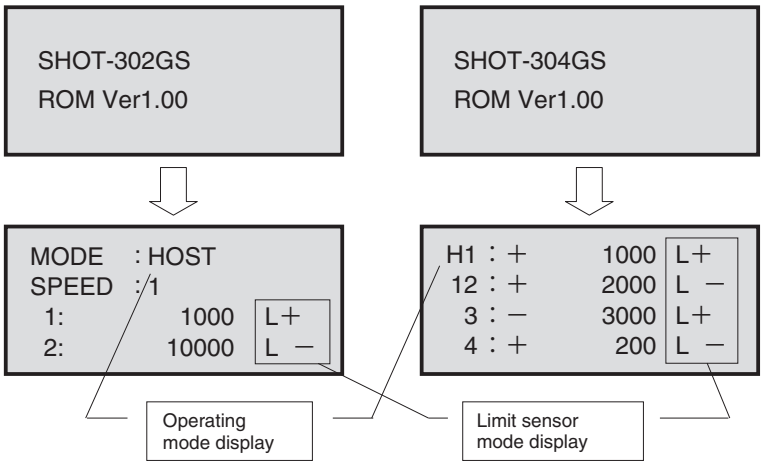
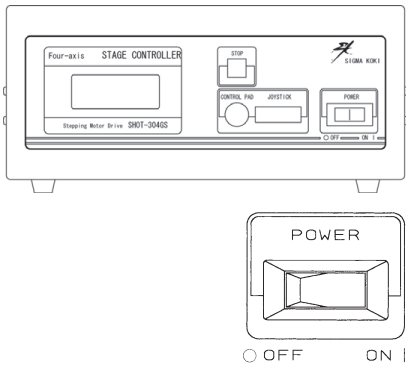


Fig. 6-2 SHOT-304GS LCD Display

Fig. 6-3 SHOT-304GS Power Switch



6-1 Operating Mode at Power On

The operating mode at power on depends on the "MODE SEL" memory switch setting, which is stored in the controller. At shipment, the memory switch is set to "HOST (COMPUTER)". The operating mode at power on can be set to any of HOST (COMPUTER), MANUAL, REMOTE (EXECUTE), TEACHING (PROGRAM), EDIT, LOAD, and TEST.

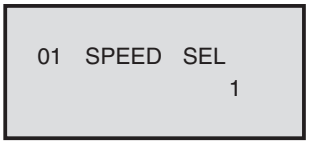
Fig. 6-4 Control pad CJ-200/ CJ200A

6-2 Changing the Operating Mode at Power On

Follow the directions below to change the operation mode at power on.
All operations use the buttons on control pad (CJ-200/CJ200A).

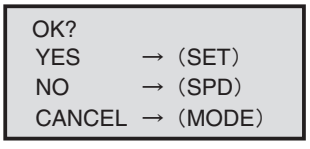
① Turn on the power of controller.
② Press the "MODE" button on the Control Pad and change the mode to MANUAL.
③ Press "Ctrl" and "SET" button simultaneously.
The memory switch setup screen will be shown.
④ Press "-2 (4) " (at bottom side) on the cross button until "MODE SEL" (Memory No.42) comes out as shown in Fig. 6-6.
⑤ Press "SET" or "SPD" button according to the mode you want to change.
Display change as in the following order : HOST→MANUAL→REMOTE→TEACHING→EDIT→LOAD→TEST.
⑥ Press "MODE" button when you finished setup. Configuration screen will appear as shown in Fig. 6-7.
(Press "MODE" button to do setup again. Press "SPD" button to cancel settings.)
⑦ Press "SET" button to return to MANUAL mode.

Memory switch setup screen (Fig. 6-5)



Operation mode select screen (Fig. 6-6)

Setup configuration screen (Fig. 6-7)



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6-3 Memory Switch Settings

The controller's internal memory switches are set to suit each of the connected stages.

Memory switches specify the speed and step angles (number of steps) for the motorized stage, and the (logical) conditions under which a stage event will be detected. (For details, see 9, "Checking and Setting Memory Switches.")

To display the memory switch settings screen in MANUAL mode, press the "Ctrl" and "SET" buttons Simultaneously.

How to operate the buttons for setting the memory switch

1) Cross-shaped -up button	Cycle through items in descending order (No. 2→1→86→85)
down button	Cycle through items in ascending order (No. 85→86→1→2).
2) Cross-shaped -right button	For numeric options, move cursor to right digit
left button	For numeric options, move cursor to left digit
3) SET button	Cycle through options for the current item (or increase the value of numeric options)
4) SPD button	Cycle through options for the current item (or decrease the value of numeric options)

Pressing the Ctrl + ORG + ZERO buttons simultaneously resets the memory switch to the defaults (factory settings).

To complete your settings, press the MODE button. This brings you to the confirmation screen, where the "SET" button is pressed to store the changed data and exit from the screen. You will be returned to the initial screen of the Manual mode.

(To exit with the changes cancelled, press the "SPD" button. To cancel the exit and set the memory switch again, press the "MODE" button.) Each motorized stage requires different memory switch settings. It may not work without the required settings. See the table below indicating the settings required for each motorized stage to work properly.

Memory Switch No.		Settings to be made	Action
302GS	304GS		
14	14	AXIS	Set it to the number of the motorized stages to be connected.
32, 33	32～35	LS/LEV	Set the input logic of the limit sensor. Select "NORMAL CLOSE" to connect a motorized stage of the SGSP /TSDM/ KST series and GS series.
47, 48	47～50	ORG SEL	Set the method of returning to the mechanical origin for each axis. Select the "MINI" method to connect a motorized stage of the SGSP/TSDM series and GS series.

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7. Changing the Operating Mode and Using the Control Pad

The control pad (CJ-200/CJ-200A) allow for smooth operation of the stage controller (SHOT-302GS/304GS) in each operating mode.

The control pad, connected to the controller via a cable, provides remote operation. This means that the control pad allows you to work near the motorized stage while checking its behavior even if the controller and the motorized stage are away from each other.

7-1. The Control Pad

There is a control pad that can be used with the stage controller (SHOT-302GS/304GS):

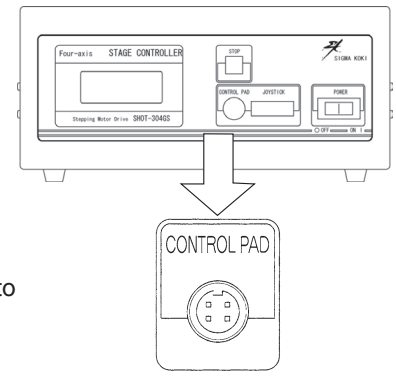
The following table shows the names of the buttons and the name used when referring to the buttons in this manual.

Button	Control pad CJ-200/ CJ-200A		Name used in this manual
Cross-shaped button	+1 (3)		**Right**
Cross-shaped button	–1 (3)		**Left**
Cross-shaped button	+2 (4)		**UP**
Cross-shaped button	–2 (4)		**DOWN**
Round button	ORG		**ORG**
Round button	SET ZERO		**ZERO**
Round button	STOP (RUN)		**STOP**
Round button	SPD		**SPD**
Round button	SET		**SET**
Round button	MODE		**MODE**
Left and right buttons on front of controller	Ctrl		**Ctrl**
Left and right buttons on front of controller	ENTER		**ENTER**
Switch	ABC		**Switch**

※CJ-200A no switch

Be sure to set the switches in the center of control pad to C position when device is connected to the Controller.

Fig. 7-1 SHOT-304GS front panel



When using the control pad (CJ-200/CJ-200A) with the stage controller, insert the (male) connector into the terminal labeled "CONTROL PAD" with the arrow mark uppermost.

Be sure the controller is off when you connect the control pad. You may not able to use the buttons on control pad if you connect or disconnect either device while the controller is on.

If you are unable to use the buttons, perform the following operations to reset the device:

◆Button reset◆

<Set the switch to A while pressing the ORG button.

Release the ORG button and return the switch to C.

※Not the button reset operation in CJ-200A

Figure 7-2 Control Pad CJ-200/CJ-200A

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7-2. Operating Modes and Control Buttons

The controller has seven operating modes. You can control motorized stages in a variety of different applications by changing modes. Press the "MODE" button on the control pad (CJ-200/CJ-200A) to cycle through operating modes in the order,

HOST → MANUAL→ REMOTE →TEACHING → EDIT → LOAD →TEST → HOST.

Press the "MODE" button while holding down the "Ctrl" button to cycle through operating modes in reverse order:

HOST →TEST → LOAD → EDIT →TEACHING → REMOTE → MANUAL→ HOST.

The various operating modes and the buttons used in each mode are outlined below.

HOST mode	Device can be controlled via transmission of signals to and from another device such as a computer. MODE/ Ctrl+ MODE
MANUAL mode	Device is operated manually using the buttons on the controller. All buttons can be used.
REMOTE mode	Device is controlled by I/O signals from an external remote device. MODE /Ctrl+ MODE/ Ctrl+ STOP
TEACHING mode	Position data can be stored as desired and transmitted to a computer. All buttons can be used
EDIT mode	Edit program data. MODE/ Ctrl+ MODE/Cross-shaped button/SET/SPD
LOAD mode	Upload and download internal data. MODE /Ctrl+ MODE/ Cross-shaped button/SET/SPD
TEST mode	Confirm input and output of I/O control signals. MODE/ Ctrl+ MODE/Cross-shaped button/SET/SPD

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8. Using the Control Pad and the JOY STICK(Jog-operation-Box) to Position Motorized Stages

In MANUAL mode, Motorized stages can be positioned using the buttons on the control pad or joy stick.

8-1. Using the Control Pad and the joystick to Control Motorized Stages

Motorized stages can be controlled using the buttons on the control pad and the joystick.

8-1-1. Control Pad

1) Cross-shaped drive button
- Right…… Move first axis in "+" direction (forward rotation)
- Left…… Move first axis in "--" direction (reverse rotation)
- Up…… Move second axis in "+" direction (forward rotation)
- Down…… Move second axis in "--" direction (reverse rotation)
- Ctrl + right: Move third axis in "+" direction (forward rotation SHOT-304GS only)
- Ctrl + left: Move third axis in "--" direction (reverse rotation SHOT-304GS only)
- Ctrl + up: Move fourth axis in "+" direction (forward rotation SHOT-304GS only)
- Ctrl + down: Move fourth axis in "--" direction (reverse rotation SHOT-304GS only)

2) Speed button SPD…… Cycle through "SPEED1/2/3/4" settings stored in memory switches (1→2→3→4→1)

3) Clear coordinates button ZERO…… Reset position coordinates for all axes to zero

4) Mechanical origin button ORG…… Position stage at mechanical origin (for those axis for which "ORIGIN1-4" memory switch is set to "ON")

5) Logical origin button Ctrl + ZERO…… Position stage at logical origin "0" for all axes

6) Trigger button ENTER…… Output pulse from trigger-output terminals on rear-panel terminal panel

7) Stop button STOP…… Stop all operating motorized stages immediately

8-1-2. Joy Stick (Jog-operation-Box)

When using the Joy Stick (JS-300) with the stage controller, insert the (male) connector into the terminal labeled "JOYSTICK".

For the details, see the User's manual of the JOY STICK (JS-300).

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9. Checking and Setting Memory Switches

Memory switch settings differ depending on the motorized stage used. Be sure to adjust memory switch settings for optimal operation of motorized stages.

9-1. Using a Control Pad to Control Motorized Stages

To display the memory switch settings screen in MANUAL mode, press the "Ctrl" and "SET" buttons simultaneously. Memory switch settings can be changed using the buttons on the control pad.

1) Cross-shaped - up button…… Cycle through items in descending order (No. 2→1→86→85)
down button …… Cycle through items in ascending order (No. 85→86→1→2)
2) Cross-shaped - right button …… For numeric options, move cursor to right digit
left button …… For numeric options, move cursor to left digit
3) SET button …… ① Cycle through options for the current item (or increase the value of numeric options)
…… ② After changes to settings have been completed, save changes to settings and exit
4) SPD button …… ① Cycle through options for the current item (or decrease the value of numeric options)
…… ② After changes to settings have been completed, cancel changes to settings and exit
5) MODE button …… ① Press to end changes to settings (a confirmation screen will be displayed)
…… ② Exit confirmation screen and return to memory switch settings screen
6) Ctrl + ORG + ZERO buttons …… restore memory switch settings to factory defaults

9-2. Setting Memory Switches: An Example

Here, you will change the detection method (logic) of the limit sensor from normal close to normal open as an example of memory switch settings.
In this example, we will change "LS/LEVI" memory switch setting item from **"NORMAL CLOSE" to "NORMAL OPEN"**.

The detection method of the limit sensor depends on the motorized stage used.
Motorized stages that support the normal open method: CGO, CKR series, etc.
Motorized stages that support the normal closed method: SGSP/TSDM/KST series and GS series.

"Normal open" is defined as OFF when the limit sensor is not detected and ON when it is detected (the signal state defaults to OFF as long as the limit sensor is not detected). "Normal close" is defined as ON when the limit sensor is not detected and OFF when it is detected (the signal state defaults to ON as long as the limit sensor is not detected).

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[Operations]

① Press the "Ctrl" and "SET" buttons on MANUAL mode simultaneously.
The memory switch settings screen will be displayed (see fig. 9-2).

② Press the "-2(4)" (down) on the cross- shaped button until "LS/LEV1" is displayed as shown in Fig. 9-3.

③ Press the "SPD" button to display "NORMAL OPEN." Press the "SPD" button to change settings in the order, "NORMAL CLOSE."→ NORMAL OPEN." Press the "SET" button to change settings in the order, "NORMAL OPEN" → "NORMAL CLOSE."

④ Press the "MODE" button when changes to settings are complete.
The confirmation screen shown in Figure 9-4 will appear, display "(YES: SET) (NO: SPD) (CANCEL: MODE)." Press the "MODE" button to return to the memory switch settings screen. Press "SPD" button to cancel changes to settings.

⑤ Press the "SET" button.
Pressing the "SET" button saves changes to settings and returns you to MANUAL mode.

Fig.9-1 Memory switch setup screen

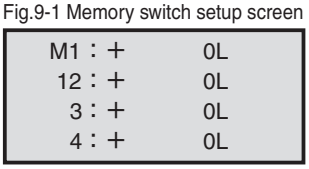


Fig.9-2 Memory Switch Settings

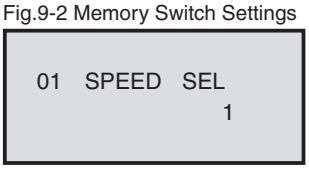


Fig.9-3 Sensor Detection Options

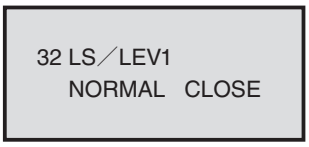
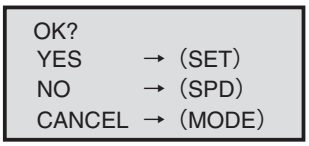


Fig.9-4 Confirmation Screen



Note:

Changes of the detection method (logic) of the limit sensor by the memory switch are limited only to switching + direction limit sensor (LS+) and – direction limit sensor (LS-). The near-point detection sensor and the mechanical origin are fixed to NORMAL OPEN.

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9-3. Memory Switch Settings

Memory switch settings will return factory defaults if you press the "Ctrl,' "ORG,' 'and "ZERO" buttons simultaneously.

302GS No.	304GS No.	Memory switch setting (display)	Range/ options	Default value
01	01	SPEED SEL	1～4	1
02	02	SPEED1 (S)	1～500000	100
03	03	SPEED1 (F)	1～500000	1000
04	04	SPEED1 (R)	0～1000	200
05	05	SPEED2 (S)	1～500000	500
06	06	SPEED2 (F)	1～500000	5000
07	07	SPEED2 (R)	0～1000	200
08	08	SPEED3 (S)	1～500000	750
09	09	SPEED3 (F)	1～500000	7500
10	10	SPEED3 (R)	0～1000	200
11	11	SPEED4 (S)	1～500000	1000
12	12	SPEED4 (F)	1～500000	10000
13	13	SPEED4 (R)	0～1000	200
14	14	AXIS	1～2(302) / 1～4(304)	2(302)/1(304)
15	15	INTERFACE	RS232C/USB/GP-IB	RS232C
16	16	BAUDRATE	4800/9600/19200/38400	9600
17	17	DELIMIT	CR/LF/CR+LF/EOI	CRLF
18	18	GP-IB ADDR	1～30	8
19	19	STAGE1 UNIT	PULSE/MICRO/DEG/SENSOR	PULSE
20	20	STAGE2 UNIT	PULSE/MICRO/DEG/SENSOR	PULSE
21	21	STAGE3 UNIT	PULSE/MICRO/DEG/SENSOR	PULSE
22	22	STAGE4 UNIT	PULSE/MICRO/DEG/SENSOR	PULSE
23	23	DIVIDE1	1/2/4/5/8/10/20/25/40/50/80/100/125/200/250	2
24	24	DIVIDE2	1/2/4/5/8/10/20/25/40/50/80/100/125/200/250	2
25	25	DIVIDE3	1/2/4/5/8/10/20/25/40/50/80/100/125/200/250	2
26	26	DIVIDE4	1/2/4/5/8/10/20/25/40/50/80/100/125/200/250	2
27	27	BASE RATE1	1～1000	20
28	28	BASE RATE2	1～1000	20
29	29	BASE RATE3	1～1000	20
30	30	BASE RATE4	1～1000	20
31	31	TRG /LEV	HI/LO	HI
32	32	LS/LEV1	NORMAL CLOSE/NORMAL OPEN	NORMAL/CLOSE
33	33	LS/LEV2	NORMAL CLOSE/NORMAL OPEN	NORMAL/CLOSE
34	34	LS/LEV3	NORMAL CLOSE/NORMAL OPEN	NORMAL/CLOSE
35	35	LS/LEV4	NORMAL CLOSE/NORMAL OPEN	NORMAL/CLOSE
36	36	MOVE1	POS/NEG	POS
37	37	MOVE2	POS/NEG	POS
38	38	MOVE3	POS/NEG	POS
39	39	MOVE4	POS/NEG	POS
40	40	POSOUT	ON/OFF	ON
41	41	TRG WIDTH	10/100/1000	10
42	42	MODE SEL	HOST/MANUAL/REMOTE/TEACHING/EDIT/LOAD/TEST	HOST
43	43	ORIGIN1	ON/OFF	ON
44	44	ORIGIN2	ON/OFF	ON
45	45	ORIGIN3	ON/OFF	ON
46	46	ORIGIN4	ON/OFF	ON
47	47	ORG1 SEL	MARK/MINI/NOR/MIDDLE	MINI

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302GS No.	304GS No.	Memory switch setting (display)	Range/ options	Default value
48	48	ORG2 SEL	MARK/MINI/NOR/MIDDLE	MINI
49	49	ORG3 SEL	MARK/MINI/NOR/MIDDLE	MINI
50	50	ORG4 SEL	MARK/MINI/NOR/MIDDLE	MINI
51	51	ORG1 (S)	1～500000	500
52	52	ORG1 (F)	1～500000	5000
53	53	ORG1 (R)	0～1000	200
54	54	ORG2 (S)	1～500000	500
55	55	ORG2 (F)	1～500000	5000
56	56	ORG2 (R)	0～1000	200
57	57	ORG3 (S)	1～500000	500
58	58	ORG3 (F)	1～500000	5000
59	59	ORG3 (R)	0～1000	200
60	60	ORG4 (S)	1～500000	500
61	61	ORG4 (F)	1～500000	5000
62	62	ORG4 (R)	0～1000	200
63	63	COMM/ACK	MAIN/SUB	MAIN
64	64	CONT1	OPEN/CLOSE	OPEN
65	65	CONT2	OPEN/CLOSE	OPEN
66	66	CONT3	OPEN/CLOSE	OPEN
67	67	CONT4	OPEN/CLOSE	OPEN
68	68	INPOS1	0～99	4
69	69	INPOS2	0～99	4
70	70	INPOS3	0～99	4
71	71	INPOS4	0～99	4
72	72	EMG MT EXCT1	OFF/ON	OFF
73	73	EMG MT EXCT2	OFF/ON	OFF
74	74	EMG MT EXCT3	OFF/ON	OFF
75	75	EMG MT EXCT4	OFF/ON	OFF
76	76	ACC CONT1	S CURVE/ LINEAR	LINEAR
77	77	ACC CONT2	S CURVE/ LINEAR	LINEAR
78	78	ACC CONT3	S CURVE/ LINEAR	LINEAR
79	79	ACC CONT4	S CURVE/ LINEAR	LINEAR
80	80	CONFIG1	ON/OFF	ON
81	81	CONFIG2	ON/OFF	ON
82	82	CONFIG3	ON/OFF	ON
83	83	CONFIG4	ON/OFF	ON
84	84	JOG LINEAR	OFF/ON	ON
85	85	JOG X SEL	1/2/3/4	1
86	86	JOG Y SEL	1/2/3/4	2

*) Black face is 304GS only.

For more information, see 9-4, “Memory Switch Settings in Detail.”

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9-4. Memory Switch Settings in Detail

The numbers in each heading indicate the number of the memory switch setting item for the SHOT-302GS/304GS.

(Non-numeric options for memory switch settings data are listed in ascending order according to the values (0,1, 2, 3, …) used at download and upload. The values used at download and upload are marked with an asterisk as follows.)

1/1) SPEED SEL: Speed selection

Choose the initial speed setting used at power on.

[Options] 1 to 4

2~13/2~13) SPEED 1 to 4 (S) (F) (R): Speed settings

Set the travel speed of stage (minimum S, maximum F, and acceleration/deceleration time R) (four settings).

[Options] S: 1 to 500000PPS
F: 1 to 500000PPS
R: 0 to 1000ms

14/14) AXIS: Specify number of axes controlled

Specify the number of stages connected or the number of axis controlled
(if one axis is selected, a second axis can not be controlled).

[Options] 1: one axis
2: two axis
3: three axes (304GS only)
4: four axes (304GS only)

15/15) INTERFACE: Interface selection

Specify the interface used to connect to the host (computer)

[Options] RS232C: RS232C interface 「*0」
USB: USB interface 「*1」
GP-IB: GP-IB interface 「*2」

16/16) BAUDRATE: Set the baud rate

Set data transfer speed for an RS-232C connection.

[Options] 4800: 4800bps 「*0」
9600: 9600bps 「*1」
19200: 19200bps 「*2」
38400: 38400bps 「*3」

17/17) DELIMIT: Delimiter selection

Choose code used to delimit blocks of data for data transfer

[Options] CR: CR 「*0」
LF: LF 「*1」
CRLF: CR+LF 「*2」
EOI: EOI (used when GP-IB interface is selected) 「*3」

18/18) GP-IB ADDR: GP-IB address selection

Choose the address for a GP-IB connection

[Options] 1 to 30

19/19) STAGE1 UNIT: Select the units used for display (first axis)

20/20) STAGE2 UNIT: Select the units used for display (second axis)

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21/21) STAGE3 UNIT: Select the units used for display (third axis) (304GS only)

22/22) STAGE4 UNIT: Select the units used for display (fourth axis) (304GS only)

Choose the units used to display position coordinates of LCD.

[Options] PULSE: ±999999999 (displays number of pulses) 「*0」

MICRO: ±999999.99 「*1」

DEG: ±999999.999 「*2」

SENSOR: ±999999.99 「*3」

23/23) DIVIDE1: Select number of steps for 1

24/24) DIVIDE2: Select number of steps for 2

25/25) DIVINE3: Select number of steps for 3 (304GS only)

26/26) DIVIDE4: Select number of steps for4 (304GS only)

Input the value for the number of steps for each axis.

[Options] M2: 1,2,4,5,8,10,20,25,40,50,80,100,125,200,250

Number of steps = DIVIDE = BASE RATE (in 0.1μm steps)/ (10 X travel per pulse (in μm))

27/27) BASE RATE 1: Travel per pulse at the base (full) step for the first axis

28/28) BASE RATE 2: Travel per pulse at the base (full) step for the second axis

29/29) BASE RATE 3: Travel per pulse at the base (full) step for the third axis (304GS only)

30/30) BASE RATE 4: Travel per pulse at the base (full) step for the fourth axis (304GS only)

Input the travel per pulse at the base (full) step for each axis. (MICRO: in 0.1-μm steps, DEG: in 0.001-degree steps)

[Options] At a setting of PULSE or SENSOR: Disabled

At a setting of MICRO: 1 to 1000 (0.1 μm to 100 μm)

At a setting of DEG: 1 to 1000 (0.001 degrees to 1 degree)

<Settings example> BASERATE = 40 for a directly motorized stage with screw lead of 2mm

Stage	XYZ linear stage						Rotation stage
Screw lead	1mm	2mm	6mm	10mm	20mm	25mm	-
Base step angles	0.72°						
Travel per pulse at base step	2 μm	4 μm	12 μm	20 μm	40 μm	50 μm	0.005°
BASE RATE	20	40	120	200	400	500	5

31/31) TRG/LEV: Logical settings for trigger output

Specify the logic (voltage levels) when the trigger-output output-signal is ON.

[Options] HI: Positive (active High) 「*0」

LO: Negative (active Low) 「*1」

32/32) LS/LEV1: Specify the input logic for the first-axis limit sensor

33/33) LS/LEV2: Specify the input logic for the second-axis limit sensor

34/34) LS/LEV3: Specify the input logic for the third-axis limit sensor (304GS only)

35/35) LS/LEV4: Specify the input logic for the fourth-axis limit sensor (304GS only)

Select the conditions (input logic) for the limit sensor for each axis.

[Options] NORMAL OPEN: Normal open (switches ON from default value of OFF when limit sensor is detected) 「*0」

NORMAL CLOSE: Normal close (switches OFF from the default value of ON when limit sensor is detected) 「*1」

Motorized stages that support normal open method: VSGSP series, etc.
Motorized stages that support normal closed method: OSMS/HPS/HDS/SGSP/TSDM/KST series and GS/CS series.

36/36) MOVE1: Direction of travel for first axis

37/37) MOVE2: Direction of travel for second axis

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38/38) MOVE3: Direction of travel for third axis (304GS only)

39/39) MOVE4: Direction of travel for fourth axis (304GS only)

Select the + direction for each axis

[Options] POS: Positive (forward) rotation 「*0」

NEG: Negative (reverse) rotation 「*1」

40/40) POSOUT: Select data output for TEACHING (PROGRAM) mode

Specify settings for data output to the host (computer) when the TRG button is pressed in TEACHING (PROGRAM) mode.

[Options] ON: Enabled 「*0」

OFF: Disabled 「*1」

41/41) TRG WIDTH: Set the pulse width of the trigger output

Specify the pulse width (time) of the trigger output.

[Options] 10 : 10 μS 「*0」

100: 100 μS 「*1」

1000: 1 mS 「*2」

42/42) MODE SEL: Set the initial operating-mode at power on.

Specify the (initial) operating mode at power on.

[Options] HOST: host (computer) mode 「*0」

MANUAL: manual mode 「*1」

REMOTE: remote (execute) mode 「*2」

TEACH: teaching (program) mode 「*3」

EDIT: edit mode 「*4」

LOAD: load mode 「*5」

TEST: test mode 「*6」

43/43) ORIGIN1: First axis origin detection

44/44) ORIGIN2: Second axis origin detection

45/45) ORIGIN3: Third axis origin detection (304GS only)

46/46) ORIGIN4: Fourth axis origin detection (304GS only)

Specify whether to return to the mechanical origin for each axis.

[Options] ON: Enabled 「*0」

OFF: Disabled 「*1」

47/47) ORG1 SEL: Specify method used for return to first-axis origin

48/48) ORG2 SEL: Specify method used for return to second-axis origin

49/49) ORG3 SEL: Specify method used for return to third-axis origin (304GS only)

50/50) ORG4 SEL: Specify method used for return to fourth-axis origin (304GS only)

Specify method used when returning to the mechanical origin for each axis.

[Options] MARK: MARK (Sigma) method 「*0」

MINI: MINI method 「*1」

NOR: standard method 「*2」

MIDDLE: median point detection method 「*3」

SGSP/TSDM/KST/GS: M/NI/MIDDLE method

51~56/51~56) ORG1/2 SPEED (S) (F) (R): Specify speed when returning to origin

57-62/57-62) ORG3/4 SPEED (S) (F) (R): Specify speed when returning to origin (304GS only)

Set the speed (minimum S, maximum F, and acceleration/deceleration time R) when returning to the

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mechanical origin for the stage on each axis.

[Options] S: 1 to 500000PPS
F: 1 to 500000PPS
R: 0 to 1000ms

63/63) COMM/ACK: Choose the communication protocol used when communicating with the computer (higher-level host)

Specify whether the controller will return OK/NG in response to command signals sent from the computer in HOST (COMPUTER) mode.

[Options] MAIN: New system (return OK/NG when using RS232C or GP-IB,USB interface) 「*0」
SUB: Old system (do not return OK/NG when using RS232C or GP-IB,USB interface) 「*1」

64/64) CONT1: Set the control method for the first axis

65/65) CONT2: Set the control method for the second axis

66/66) CONT3: Set the control method for the third axis (304GS only)

67/67) CONT4: Set the control method for the fourth axis (304GS only)

Set the control method (open loop or closed loop method) for each axis.

[Options] OPEN: open loop control method 「*0」
CLOSE: closed loop control method 「*1」

68/68) INPOS1: set the in-position range of the first axis when the closed loop method is selected

69/69) INPOS2: set the in-position range of the second axis when the closed loop method is selected

70/70) INPOS3: set the in-position range of the third axis when the closed loop method is selected (304GS only)

71/71) INPOS4: set the in-position range of the fourth axis when the closed loop method is selected (304GS only)

Set the in-position range (range of the positioning stop at the time of positioning) for each axis when the closed loop is selected

[range] 0-99 degrees

"Ideology of the in-position range (0-99)"

The value specified for the in-position range completes the positioning if the travel reaches this range against your travel instruction.

The range of 0-99 was determined based on Scale resolution, the precision per pulse from the glass-scale.

<Examples : Scale resolution → 0.1 μm>

Set value = 0 range from 0-+0.1 μm

Set value = 1 1 x ±0.1 = range of ±0.1 μm

Set value = 99 99 x ±0.1 = range of ±9.9 μm

72/72) EMG MT EXCT1: set the excitation ON/OFF of the first axis when the emergency stop

73/73) EMG MT EXCT2: set the excitation ON/OFF of the second axis when the emergency stop

74/74) EMG MT EXCT3: set the excitation ON/OFF of the third axis when the emergency stop (304GS only)

75/75) EMG MT EXCT4: set the excitation ON/OFF of the fourth axis when the emergency stop (304GS only)

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[Options] ON: free motor 「*0」
OFF: excitation 「*1」

76/76) ACC CONT1: set the speed-acceleration profile of the first axis
77/77) ACC CONT2: set the speed-acceleration profile of the second axis
78/78) ACC CONT3: set the speed-acceleration profile of the third axis (304GS only)
79/79) ACC CONT4: set the speed-acceleration profile of the fourth axis (304GS only)

[Options] S CURVE: S curve control 「*0」
LINEAR: trapezoidal control 「*1」

80/80) CONFIG1: Select Auto-Config mode of the first axis
81/81) CONFIG2: Select Auto-Config mode of the second axis
82/82) CONFIG3: Select Auto-Config mode of the third axis (304GS only)
83/83) CONFIG4: Select Auto-Config mode of the fourth axis (304GS only)

[Options] ON: effect 「*0」
OFF: no effect 「*1」

84/84) JOG LINEAR：Select the function of the linear interpolation motion or NOT during jog operating peripheral controller, JS-300 or JB400.

When ON is selected, connect the Stages in the order of axis from the First axis.
If connected from the Second axis, it doesn't work properly.

〔Options〕 OFF: Function of the linear interpolation motion OFF 「*0」
ON : Function of the linear interpolation motion ON 「*1」

85/85) JOG X SEL ：Select the axis of the Stage correspond in operation by the X direction of the peripheral controller, JS-300 or JB-400.

Note：Select different axis for 85) and 86)

[Options] 1：First axis
2：Second axis
3：Third axis (SHOT-304GS only)
4：Fourth axis (SHOT-304GS only)

86/86) JOG Y SEL： Select the axis of the Stage correspond in operation by the Y direction of the peripheral controller, JS-300 or JB-400.

Note：Select different axis for 85) and 86)

〔Options〕 1：First axis
2：Second axis
3：Third axis (SHOT-304GS only)
4：Fourth axis (SHOT-304GS only)

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10. Using a Computer to Position Motorized Stages

The controller can be connected to a computer using an RS232C, GPIB, or USB interface. Motorized stages can then be precisely controlled by commands (strings) transmitted from the computer.

Note that some of the commands used by the SHOT-302GS/ 304GS are different from those used in existing controllers.

The controller will enter HOST mode the first time you turn it on. (See Fig. 10-1)

Fig. 10-1

H1	: +	1000	L+
12	: −	10000	L −
3	: +	1000	L+
4	: −	10000	L −

10-1. Control Pad Operations

Because the controller is controlled from the computer, only the mode selection buttons (MODE and Ctrl+ MODE) can be used in HOST mode.

10-2. List of Commands

The following is a list of available commands:

Command	String	Details	Response
Control Commands 1 (Drive Commands)			
Return to mechanical origin	H	Detect mechanical origin	When new system (MAIN) is used: Command received normally: OK Problem receiving command: NG When old system (SUB) is used: No response
Set number of pulses for relative movement	M	Axis of movement, direction, number of pulses	
Set number of pulses for absolute movement	A	Absolute coordinates	
Settings for rotary movement	E	Circular interpolation (Move at minimum speed (S))	
Settings for linear movement	K	Linear interpolation (Move at minimum speed (S))	
Jog command	J	Move at minimum speed (S)	
Drive command	G	Start	
Control Commands 2 (Settings)			
Set electronic (logical) origin	R	Set the electronic (logical) origin to the current position	When new system (MAIN) is used: Command received normally: OK Problem receiving command: NG When old system (SUB) is used: No response
Stop	L	Stop or reduce speed	
Speed settings	D	Set S, F, and R	
Alarm reset	U	Alarm reset	
Wait	W	Specify command wait time	
Trigger output	T	Trigger output	
Free motor	C	Excitation ON/OFF	
Switch number of steps	S	Switch number of steps	
Confirmation Commands			
Status1	Q	Return current position etc.	Described elsewhere
Status2	!	Return B/R (READY)	
Internal information	?	Check internal information	
I/O Commands			
Output	O	Output to I/O connector	When new system (MAIN) is used: Command received normally: OK Problem receiving command: NG When old system (SUB) is used: No response
Input	I	Input from I/O connector	Described elsewhere
Other Commands			
Mode change	P: R	Enter program mode	When new system (MAIN) is used: Command received normally: OK Problem receiving command: NG When old system (SUB) is used: No response
	P: H	Enter host mode	
Mode change	P: P1 or P2	Specify program number (1 or 2)	
Start command	P: S	Start independent programmed operation	
Stop command	P: E	Stop independent programmed operation	
Pause command	P: U0	Pause program	
Pause cancel	P: U1	Cancel program pause	
Select signal sent on completion of operation	P: C0	Signals can not be sent at completion of programmed operation	
	P: C1	Signals is sent at completion of programmed operation	
Select signal sent on Trigger	P: T0	Trigger signal can not be sent at trigger signal output	
Signal output	P: T1	Trigger signal is sent at trigger signal output	

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10-3. Command Format

The communications protocol used between the controller and the computer depends on the memory switch COMM/ACK.

1. When COMM/ACK is set to MAIN (new system):
   A protocol is used in which one response is issued for each command.
   Command string ····· receive
   Response string ····· sent
   The response string when a command is received normally is "OK," that when the command was not received, "NG." In some cases, for example in response to confirmation commands, data will be returned instead of "OK." Commands should only be sent after checking the internal status of the controller.
2. When COMM/ACK is set to SUB (old system):
   A protocol is used in which the controller does not respond to each command. Data will however be returned in response to some commands, such as confirmation commands.
   To determine whether or not a command was received normally, use the Q command to check status.

10-4. Commands in Detail

Commands are categorized as follows:
1) Control commands ① (drive commands)
2) Control commands ② (settings)
3) Confirmation commands
4) I/O commands
5) Other commands

1) Control commands 1 (drive commands)

(1) H command: Return to mechanical origin

Features: This command is used to detect the mechanical origin for a stage and set that position as the origin. Once the mechanical origin has been detected, the value displayed will be 0. The stage will move at the speed specified in the ORG1 (2) SPEED (S, F, R) memory switches.

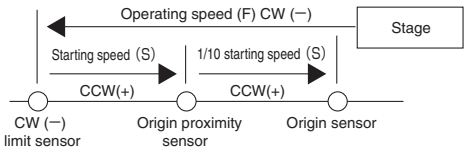
H: 1 Detect the mechanical origin for the first axis.
H: 2 Detect the mechanical origin for the second axis.
H: 3 Detect the mechanical origin for the third axis. (SHOT-304GS)
H: 4 Detect the mechanical origin for the fourth axis (SHOT-304GS).
H: W Detect the mechanical origin for the first and second axes (detect the mechanical origin for the first, second, third, and fourth axes when SHOT-304GS is used).

The stage can be stopped using L: E

＜Detecting the Mechanical Origin＞

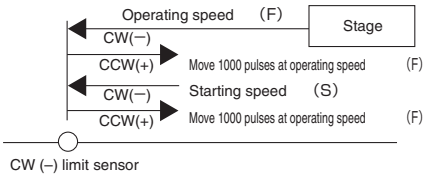
MARK (Sigma) system

When the command is given to detect the mechanical origin, the stage begins moving clockwise (i.e., in the - direction) at the operating speed (F) specified in the memory switches, stopping when the clockwise (-) limit sensor is detected. It then moves counter-clockwise (i.e., in the + direction) at the starting speed (S) until the origin proximity sensor is detected, at which point it reduces speed to 1/10. The stage continues moving until the origin sensor is detected and then stops (CKR series, etc.).



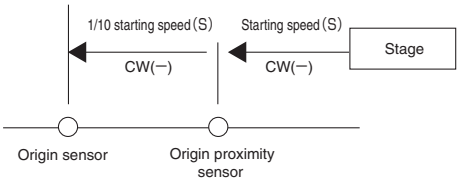
MINI system

When the command is given to detect the mechanical origin, the stage begins moving clockwise (i.e., in the - direction) at the operating speed (F) specified in the memory switches, stopping when the clockwise (-) limit sensor is detected. It then moves counter-clockwise (i.e., in the + direction) at the operating speed (F) for 1000 pulses. After stopping, it begins moving clockwise (i.e., in the - direction) once more at the starting speed (S), stopping when the clockwise (-) limit sensor is reached. It then moves counter-clockwise (i.e., in the + direction) at the operating speed (F) for 1000 pulses. This position is taken as the mechanical origin (SGSP series).



Standard (NOR) system

When the command is given to detect the mechanical origin, the stage begins moving clockwise (i.e., in the - direction) at the starting speed (S) specified in the memory switches. When the origin proximity sensor is detected, speed is reduced to 1/10. The stage continues moving in clockwise (i.e., in the - direction) until the origin sensor is detected, at which point the stage stops



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(2) M command: Set number of pulses for relative travel

Features: This command is to specify the axis of travel, direction, and the travel (number of pulses).
This command must always be followed by a drive (G) command. Travel is by means of acceleration/deceleration driving.
The distance travelled is specified in pulses.
"Unit of travel" Open loop control: number of pulses (SHOT-302GS/304GS: open loop)
Closed loop control: μm (SHOT-302GS/304GS: closed loop)

M: 1+P1000	Travel 1000 pulses in the + direction on the first axis
G:	
M: 2- P 10000	Travel 10000 pulses in the - direction on the second axis
G:	
M: 3+P5000	Travel 5000 μm in the + direction on the third axis (SHOT-304GS: closed loop)
G:	
M: 4-P9000	Travel 9000 pulses in the - direction on the fourth axis (SHOT-304GS)
G:	
M: W+P500-P200	Travel 500 pulses in the + direction on the first axis and 200 pulses in the -
G:	direction on the second axis
M: W+P50-P20+P30+P100	Travel 50 pulses in the + direction on the first axis, 20 pulses in the - direction on the second axis, 30 pulses in the + direction on the third axis, and 100 pulses in the+ direction on the fourth axis (SHOT-304GS:open loop)
G:	

The SHOT-302GS/304GS carries out the closed loop control, if CONT 1～4 are set to "CLOSE," and open loop control, if set to "OPEN."

If you have an axis that is not driven, you need to designate P0 for that axis.
M: W+P100+P0+P200+P0
Travel 100 pulses in the + direction on the first axis, 200 pulses in the + direction on the third axis, move, and the second and fourth axes are not driven.

(3) A command: Set number of pulses for absolute travel

Features: This command is to specify the axis of travel, direction, and the travel (number of pulses).
This command must always be followed by a drive (G) command. Travel is by means of acceleration/deceleration driving.
The distance traveled is specified in μm or the number of pulses depending on the control method. This command also returns the axis to the electrical (logical) origin.
"Unit of travel" Open loop control: number of pulses (SHOT-302GS/304GS: open loop)
Closed loop control: μm (SHOT-302GS/304GS: closed loop)

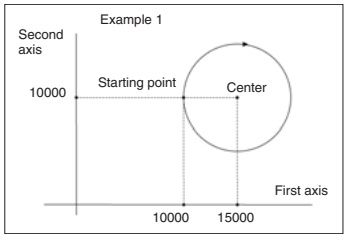
A: 1-P2000	Travel to the 2000 pulse position in the - direction on the first axis.
G:	
A: 2+P30000	Travel to the 30000 pulse position in the + direction on the second axis.
G:	
A: 3+P500	Travel to the 500 μm position in the + direction on the third axis (SHOT- 304GS:closed loop)
G:	
A: 4-P200	Travel to the 200 pulse position in the - direction on the fourth axis (SHOT-304GS)
G:	
A: W+P1000-P2000	Travel to the 1000 pulse position in the + direction on the first axis and the 2000 pulse position in the - direction on the second axis
G:	
A: 1+P0	Moves the first axis to the electrical (logical) origin.
G:	

(4) E command: Settings for rotary movement (circular interpolation)

Features: This command is to specify the direction and amount (in pulses) of travel for simultaneous circular travel on two axes.
This command must always be followed by a drive (G) command.
The speed of travel is the minimum speed (S)(1axis). The coordinates for the final position are given in pulses (only the first and second axes may be set)

E: W +P0 +P0 +P2000 +P100
Final coordinates Central coordinates
G:

With the center for circular travel set to the 2000 pulse position in the + direction on the first axis and the 100 pulse position in the + direction on the second axis, travel Final coordinates Central coordinates by circular interpolation in a full circle from the present position to the final position.



(EX1) E: W +P0 +P0 +P5000 +P0
G:

Travel in a circle to the final position, with the center of the circle being given using the relative coordinates (5000, 0) measured from the present position (travel is always clockwise).

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(5) K command: Settings for linear travel (linear interpolation)

Features: This command is to specify the direction and amount (in pulses) of travel for simultaneous linear travel on two axes. This command must always be followed by a drive (G) command. The speed of travel is the minimum speed (S)(1axis). The coordinates for the final position are given in pulses (only the first and second axes may be set).

K: W + P1000 + P500
Final coordinates

Travel using linear interpolation to the 1000 pulse position on the first axis and the 500 pulse position on the second axis

G:

(6) J command: JOG

Features: This command drives stages continuously (at a constant speed) at the starting speed (S).
This command must always be followed by a drive (G) command.

J:1＋ move in the + direction on the first axis.
G:
J:2－ move in the - direction on the second axis.
G:
J:4－ move in the - direction on the fourth axis（SHOT-304GS）
G:
J:W－＋ move in the - direction on the first axis and in the + direction on the second axis
G:
J:W－＋＋－ move in the - direction on the first axis, in the + direction on the second- and third-axis, and in the direction on the fourth axis（SHOT-304GS）
G:

(7) G command: Drive

Features: When a drive command is issued, the stage starts moving, moves the specified number of pulses, and then stops. The G command is used after M, A, J, K, and E commands.

G: Drive

2) Control commands 2 (settings)

(8) R command: Return to electronic (logic) origin

Features: When this command is executed, the stage decelerates and stops.

R:1 Set the electronic (logical) origin for the first axis
R:2 Set the electronic (logical) origin for the second axis
R:3 Set the electronic (logical) origin for the third axis (SHOT-304GS)
R:4 Set the electronic (logical) origin for the fourth axis (SHOT-304GS)
R:W Set the electronic (logical) origins for the first- and second-axis（set the electronic origins for the first-, second-, third-, and fourth-axis when the SHOT-304GS is used）

(9) L command: Decelerate and stop

Features: When this command is executed, the stage decelerates and stops.

L:1 First axis decelerates and stops
L:2 Second axis decelerates and stops
L:3 Third axis decelerates and stops (SHOT-304GS)
L:4 Fourth axis decelerates and stops (SHOT-304GS)
L:W First- and second-axis decelerate and stop(first-, second-, third-, and fourth-axis Decelerate and stop when SHOT-304GS is used）

(10) L: E command: Emergency stop

Features: This command stops all stages immediately, whatever the conditions.

L:E Stop first and second axes immediately (stop first-, second-, third-, and fourth-axis immediately when SHOT-304GS is used)

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(11) D command: Speed settings

Features: The minimum speed (S), maximum speed (F), and acceleration/deceleration time (R) are set according to the SPEED SEL memory switches when the power is turned on. This command allows you to change these initial settings.
The following options are available:

Minimum speed（S）	1～500000PPS
Maximum speed（F）	1～500000PPS
Acceleration/deceleration time（R）	0～1000mS

Note that the minimum speed (S) must be less than or equal to the maximum speed (F).

D：1S100F1000R50　Adjust speed settings for the first axis（S=100PPS／F=1000PPS／R=50ms）
D：2S1000F5000R200　Adjust speed settings for the second axis（S=1000PPS／F=5000PPS／R=200ms）
D：4S200F2000R100　Adjust speed settings for the fourth axis（S=200PPS／F=2000PPS／R=100ms）（SHOT-304GS）
D：WS100F1000R200S100F1000R200　Adjust speed settings for the first- and second-axis

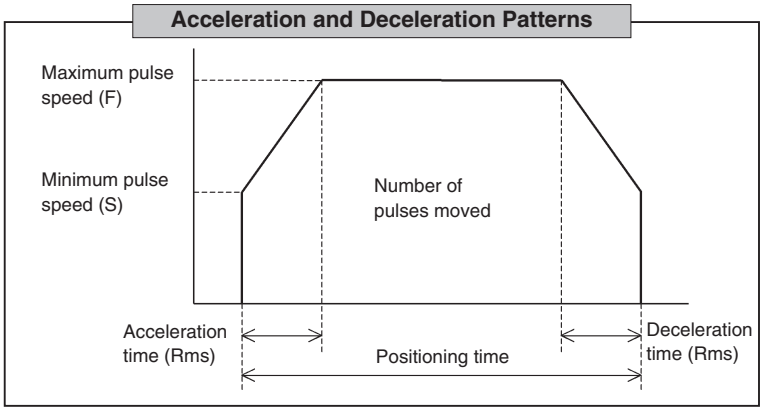
First-axis speed settings　Second-axis speed settings

D: WS100F1000R50S100F1000R50S200F2000R100S300F3000R200　Adjust speed settings for the first-, second-, third-, and fourth-axis (SHOT-304GS)

First-axis speed settings　Second-axis speed settings　Third-axis speed settings　Fourth-axis speed settings

"Requirements for settings "
S≦F
Where F＜8000PPS,
1≦(S,F)≦8000PPS
Where F≧8000PPS,
64≦(S,F)≦2000000PPS

Acceleration and Deceleration Patterns



(12) U command: Reset alarm

Features: This command resets the alarm when an error occurs.

U: 1	Resets the alarm for the first axis	
U: 2	Resets the alarm for the second axis	
U: 3	Resets the alarm for the third axis	(SHOT-304GS)
U: 4	Resets the alarm for the fourth axis	(SHOT-304GS)
U: W	Resets the alarm for the first and second axes (first, second, third, and fourth axes for the SHOT-304GS)	

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(13) W command: Set wait time

Features: This command specifies the time between stage move operations. Values range from 1 to 2550 (0.1 to 255.0 seconds).

W：255　　Wait 25.5 seconds before the next move

(14) T command: Send trigger output

Features: This command outputs a trigger (terminal panel) to for each specified position, travel pulse, or interval. Data can be collected by position coordinates or time (the pulse width of the trigger signal can be set to 10 ms, 100 ms or 1 ms using the WIDTH memory switch).

T: T [time value]　　Triggers output at specified intervals
[Time value]　1 to 10000 (0.01 to 100.00 seconds)

T: P [axis] P [pulse value]　　Triggers output for the specified axis each time the stage moves the specified number of pulses
[Axis]　1 or 2
[Pulse value]　2 to 30000

T: S　　Prevents pulse output

T: M　　One trigger is output when this command is received

(15) C command: Free/ hold motor (Excitation ON/OFF)

Features: This command is used to excite the motor or to turn excitation off, making it possible to move (rotate) stages manually. The options available are 0: free motor, and 1: excitation (hold motor).

C：10　　Free first-axis motor

C：21　　Excite (hold) second-axis motor

C：31　　Excite (hold) third-axis motor（SHOT-304GS）

C：40　　Free fourth-axis motor（SHOT-304GS）

C：W1　　Excite (hold) both the first- and second-axis motors (excite all of the first-, second-, third-, and fourth-axis motors when SHOT-304GS is used)

(16) S command: Changing the number of steps

Features: Use this command to change motor step angle (number of steps) Select one of the following 15 step angles built into the driver. First specify an axis, then set the value.

(Note) If the closed loop control is selected, the travel per pulse must not be more than 0.5μm (0.05μm recommended).

S: 180　Divides the step angle of the first axis into 80 angles.

S: 280　Divides the step angle of the second axis into 80 angles.

S: 380　Divides the step angle of the third axis into 80 angles (SHOT-304GS).

S: 480　Divides the step angle of the fourth axis into 80 angles (SHOT-304GS).

If the base step (full step) angle is to 0.72 degrees, the stepping motor makes one full turn every 500 pulses. The motor is said to have a minimum resolution of 0.72 degrees (if the motor moves 10 mm for each turn, minimum resolution=10 mm ÷ 500 pulses=20 mm). You can change the minimum resolution by dividing the motor step angle (1/2=0.36°).

Effects of dividing step angle for a motor with a basic step angle of 0.72 degrees and a movement rate of 10 mm per turn

Number of steps	1	2	4	5	8	10	20	25	40	50	80	100	125	200	250
Step angle	0.72°	0.36°	0.18°	0.144°	0.09°	0.072°	0.036°	0.0288°	0.018°	0.0141°	0.009°	0.0072°	0.00576°	0.0036°	0.00288°
Number of pulses per full turn	500	1000	2000	2500	4000	5000	10000	12500	20000	25000	40000	50000	62500	100000	125000
Resolution	2μm	1μm	0.5μm	0.4μm	0.25μm	0.2μm	0.1μm	0.08μm	0.05μm	0.04μm	0.025μm	0.02μm	0.016μm	0.01μm	0.008μm

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3) Confirmation commands

(1) Q command: Status 1

Features: On receipt of this command, the controller returns the coordinates for each axis and the current state of each stage.

Q:

−100, −200, ACK1, ACK2, ACK3 …… Data returned（SHOT-302GS）

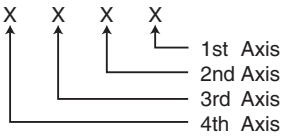
First-axis coordinates	Second-axis coordinates	Three-character string data

−100, −200, 100, 1000, ACK1, ACK2, ACK3 …… Data returned）

First-axis coordinates	Second-axis coordinates	Third-axis coordinates	Fourth-axis coordinates	Three-character string data

ACK1 ……X ：Command or parameter errors.
K ：Command received normally.

ACK2 ……「SHOT-302GS」
L ：First axis stopped at LS
M ：Second axis stopped at LS
W：First and second axes stopped at LS
K ：Normal stop



「SHOT-304GS」
1 to E: LS stop axis display
Example 1） 1 ：1: First axis stopped at LS
Example 2） E ：Second-, third-, and forth-axis stopped at LS
W：First-, second-, third-, and forth-axis stopped at LS
K ：Normal stop
R : Alarm stop (To check the factor, use the I command)

ACK3 ……B ：(BUSY) L, I, O, Q, ! , and P commands can be received
R ：(READY) all commands can be received

※Coordinate values for each axis have a fixed length of ten digits, including symbols
(Symbols are left-aligned, coordinates values right-aligned).

(2) ! command: Status 2

Features: On receipt of this command, the controller returns the stage operating status.

! :
ACK3 …… Data returned
ACK3 …… B：(BUSY) L, I, O, Q, ! , and P commands can be received
R：(READY) all commands can be received

(3) ? command: Request for internal information

Features: This command returns controller settings.

?: [Parameter] [AXIS]

[Parameter]	[Data returned]	[Examples]
V	Version numbers	V1.00
P	Travel per pulse	1.00
D	Travel speed	S100F1000R200
M	Size of relative linear pulses	1000
A	Size of absolute linear pulses	1000
O	Last output	15
W	Last settings value	255
K	Last settings value	1000, 1000
E	Last settings value	0, 0, 100, 100
[AXIS]	1, 2, 3, 4, W	

Note that V, O, W, E, and K have no [AXIS].

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4) I/O commands

(1) I command: Input

Features: This command checks the status of input (IN1-4) to the I/O connector and the nature of the alarm.

I:

15, 00, 00 ·····Value of data returned (SHOT-302GS)

I:

15, 00, 00, 00, 00 ·····Value of data returned (SHOT-304GS)

Alarm numbers of the first through fourth axes (00, S1～S3)

Status of the input signal (0～15)

《List of the alarms for the SHOT-302GS/304GS》

Alarm No.	Name of alarm	Description	Remarks
00	In order	In order	
S1	Sensor out of order	Generates an alarm when the alarm output of the glass-scale is out of order while being monitored (Abnormal conditions such as broken wires between the detection head and detector).	Scale
S2	Broken wire detected	Generates an alarm when the encoder does not return a signal against the stage slightly moved. (It detects disconnected connectors and others.)	Scale
S3	Control out of order	Generates a warning when the axis does not reach the in-position after the specified number of controls. (It detects malfunction of the driver, inconsistency of the number of steps, and others.)	Scale

《List of the Status of the input signal》

Input	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
IN1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
IN2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
IN3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
IN4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON

*) OFF indicates that the contact is open, and ON that it is closed.

(2) O command: Output

Features: Use this command to specify the output (OUT 1~ 4) to the I/O connector.

O：15 ……Parameter values are from 0 to 15

Output	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Out1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
Out2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
Out3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
Out4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON

*) OFF indicates that the contact is open, and ON that it is closed.

5) Other commands

(1) P command: Extended commands (for remote operation)

Features: This command is used to determine position according to a controller-internal program by inputting commands for remote operation in place of external control signals from host mode.

P: R	Enter program mode
P: H	Return to host mode
P: P [No.]	Set program number (1 or 2) [No.] 1, 2
P: S	Start independent programmed operation
P: E	Stop independent programmed operation
P: U0	Temporarily suspend independent programmed operation
P: U1	End temporary pause of independent programmed operation
P: C0	Prevent transmission of "operation complete" (COMP) signal when programmed operation is completed
P: C1	Allow transmission of "operation complete" (COMP) signal when programmed operation is completed
	※ The controller will send the data string "COMP" when programmed operation is completed
P: T0	Prevent transmission of trigger signal data (TRIG) when trigger is output
P: T1	Allow transmission of trigger signal data (TRIG) when trigger is output
	※The controller will send the data string "TRIG" when trigger signal is output

***) In Program Mode unlike Remote Mode by I/O signal cannot work.**

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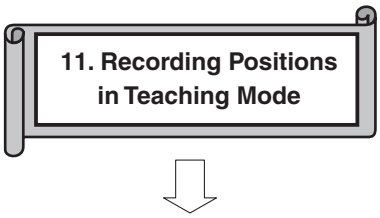
Chapter 3: Commonly Used Features

The basic operations needed to position motorized stages are outlined below, with cross-references to the sections of the manual in which these operations are described in detail.

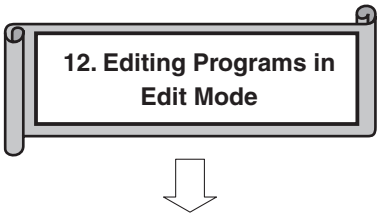
Mastering these operations will acquaint you with SHOT-302GS/304GS controllers and their operation.



Determining positions in TEACHING mode (TEACHING: T)

Coordinates can be recorded in a program by moving motorized stages to the desired position and pressing the ENTER button in TEACHING mode.

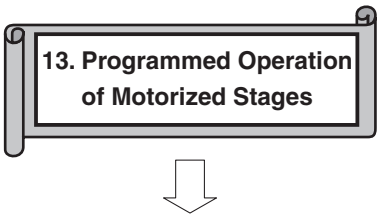
[See] 11-1 Recording Selections and Operating Motorized Stages ☞ Page 45
11-2 Example of Entry Operations in TEACHING (PROGRAM) Mode ☞ Page 47



Editing programs in EDIT mode (EDIT: E)

In EDIT mode, you can edit and record patterns of operation, coordinates for the first and second axes, output directions, speed settings, and wait times.

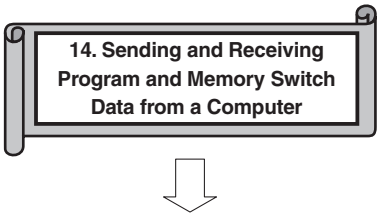
[See] 12-1 Recording Selections and Data Input ☞ Page 49
12-2 Editing Programs: An Example ☞ Page 49
12-3 Explanation of Program Data ☞ Page 50



Operating motorized stages in REMOTE mode (REMOTE: R)

Control motorized stages by selecting, executing, pausing, and terminating programs via control signals from the I/O connectors on the rear panel. The same operations can be performed using computer commands.

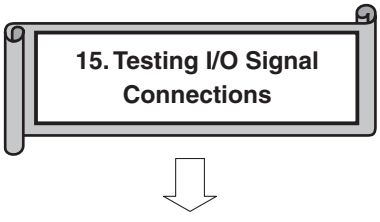
[See] 13-1 Starting Programmed Operations from a Control Pad ☞ Page 53
13-2 Starting Programmed Operations from a Computer ☞ Page 54
13-3 Starting Programmed Operations Using I/O Signals ☞ Page 54



LOAD mode operations (LOAD: L)

Upload program or memory switch data to, or download program or memory switch data from, the controller.

[See] 14-1 Control Pad Operations ☞ Page 55
14-2 Example of Upload and Download Operations ☞ Page 55
14-3 Example of Format for Downloaded Data ☞ Page 56
14-4 Example of Format for Uploaded Data ☞ Page 57



TEST mode operations (TEST: S)

Check connections and wiring for control signals from the I/O connectors on the rear panel.

[See] 15-1 Control Pad Operations ☞ Page 58
15-2 Example of Input Signal Monitoring ☞ Page 58
15-3 Example of Output Signal Testing ☞ Page 59

The programs created in TEACHING or EDIT mode are in REMOTE mode executed.

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11. Recording Positions in TEACHING Mode

In teaching mode, you can move motorized stages to the desired position using the buttons on the control pad and record position data to an internal program or computer.

11-1. Recording Selections and Operating Motorized Stages

Using the buttons on the control pad, you can select programs, record data, and operate motorized stages.

1) Record buttons

Cross-shaped, up, and down ……Cycle through program numbers in the order No.1→2→1

SET ……①In the TEACHING PROGRAM mode start-up screen, press this button to begin teaching operations

……②On exiting TEACHING mode, press this button to exit and record changes to settings

SPD ……On exiting TEACHING mode, exit without saving changes to settings

MODE ……①Press to exit TEACHING mode (a confirmation screen will be displayed)

……②In the confirmation screen displayed at completion of TEACHING mode operations, press MODE to return to TEACHING mode

2) Cross-shaped drive button Righ ……Move first axis in "＋" direction (forward rotation)

Left ……Move first axis in "－" direction (reverse rotation)

Up ……Move second axis in "＋" direction (forward rotation)

Down ……Move second axis in "－" direction (reverse rotation)

Ctrl+ right ……Move third axis in "＋" direction

Ctrl+ left ……Move third axis in "－" direction

Ctrl+ up ……Move fourth axis in "＋" direction

Ctrl+ down ……Move fourth axis in "－" direction

3) Speed button SPD ……Cycle through "SPEED1/2/3/4" settings stored in memory switches (1→2→3→4→1)

4) Clear coordinates button ZERO ……Reset position coordinates for all axes to zero

5) Mechanical origin button ORG ……Position stage at mechanical origin (for those axis for which"ORIGIN 1－4" memory switch is set to "ON")

6) Logical origin button Ctrl＋ZERO ……Position stage at logical origin "0" for all axes

7) Trigger button ENTER ……①Record relative position data and send to computer

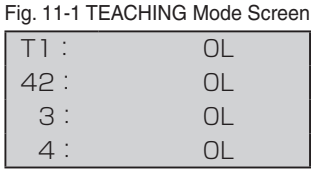
……②Output pulse from trigger-output terminals on rear-panel terminal panel

8) Stop button STOP ……Stop all operating motorized stages immediately

11-2. Example of Entry Operations in TEACHING Mode

This example illustrates how to enter position data while operating motorized stages using the SHOT-304GS.

Fig. 11-1 TEACHING Mode Screen

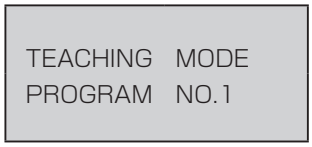


[Operations]

1. From the TEACHING (PROGRAM) mode screen, press the "SET" button to display the program numbers screen (Fig. 11-2).

2. Select a program number by pressing the top or bottom of the cross-shaped button. Press the top or bottom of the button to cycle through settings No. 1→No. 2→No. 1)

Fig. 11-2 Program Number Selection



In this example, position data will be recorded in Program No. 1. Press the "SET" button when "PROGRAM NO. 1" is displayed. The TEACHING (PROGRAM) mode screen will appear. At this point the buttons on the controller can be used to operate the motorized stage.

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3. Move the motorized stages to the desired positions using the buttons on the control pad. To record the position of the motorized stage on each axis, press the ENTER button. The relative positions for each axis will be recorded and the relative positional coordinates will be displayed as long as the ENTER button is held down, as shown in Figure 11-4. At the same time, the following operations are performed:
   - The relative positional coordinates for axes 1 and 2 are recorded in Program 1.
   - The relative positional coordinates for axes 1 through 4 are transmitted to the computer.

     (Example of transmission format): 1234, 100, 0, 0)

   ※The current coordinates are transmitted to external devices if the POSUT memory switch is set to allow transmission of data to external devices.

     POSOUT ON: Transmission enabled

     POSOUT OFF: Transmission disabled
   - A pulse is output from the trigger output terminal in the terminal panel on the rear panel. The relative positional coordinates for any number of points can be entered by repeating the above operations.

4. Press the "MODE" button when entry is complete.
   The confirmation screen shown in Figure 11-5 will appear with the display, "(YES: SET) (NO: SPD) (CANCEL: MODE)." Press the "MODE" button to make further changes to position data. Press the "SPD" button to exit without saving position data.

5. Press the"SET" button
   Position data will be saved and the initial screen for TEACHING (PROGRAM) mode will be displayed.

Fig. 11-3 TEACHING Screen

```
T1 :      + 1234L
42 :       + 100L
 3 :         + 0L
 4 :       + 789L
```

Fig. 11-4 Entering Position Data

```
Line  No.  1
1234,  100,  0,  789
```

```
Line  No.  2
1000,  900,  220,  0
```

```
Line  No.  3
− 500,  350,  0,  100
```

Fig. 11-5 Confirmation Screen

```
OK ?
 YES      → (SET)
 NO       → (SPD)
 CANCEL   → (MODE)
```

Only relative coordinate positional data for each line number in the program can be recorded in TEACHING mode. Other data (operating patterns, output instructions, speed settings, and wait times) can be edited in EDIT mode.

(Table 1) Example of relative positional coordinates entered in Program No. 1

①Line number	②Operating pattern	③First-axis coordinate	④Second-axis coordinate	⑤Output instruction	⑥Speed setting	⑦Wait time
1	0	1234	100	0	1	0
2	0	1000	900	0	1	0
3	0	–500	350	0	1	0
4	99	—	—	—	—	—
⋮						
8000						

Programs can only record coordinates for the first and second axes.

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12. Editing Programs in EDIT Mode

In EDIT mode, you can edit program data stored inside the controller.

There are two programs, No. 1 and No. 2.

12-1. Recording Selections and Data Input

Programs can be edited using the buttons on the control pad

1) Record buttons

Cross-shaped, up, and down ……Cycle through program numbers in the order No.1→2→1→2

SET ……①In the EDIT mode start-up screen, press this button to begin editing

……②On the confirmation screen, press this button to exit and record changes to settings

SPD ……On the confirmation screen, exit without saving changes to settings

MODE ……①Press to exit EDIT mode (a confirmation screen will be displayed)

……②In the confirmation screen displayed at completion of EDIT mode operations, press MODE to return to EDIT mode

2) Data-entry buttons

cross-shaped, up ……Scroll through program line numbers in descending order (No.5→4→3→2)

cross-shaped, down ……Scroll through program line numbers in ascending order (No.1→2→3→4)

cross-shaped, right ……Move the edit cursor to the right

cross-shaped, left ……Move the edit cursor to the left.

SET ……Make changes to the selected item (numerical data increases)

SPD ……Make changes to the selected item (numerical data decreases)

12-2. Explanation of Program Data

This example illustrates how to edit programs with the SHOT-304GS.

[Operations]

① From the EDIT mode screen, press the "SET" button.
The program-number selection screen will appear.

② Select a program number by pressing the top or bottom of the cross-shaped button. Press the top or bottom of the button to cycle through settings. (No. 1→No. 2→No. 1)
In this example, position data will be recorded in Program No. 1. Press the "SET" button when "PROGRAM NO. 1 is displayed. The screen will change to program data Edit mode.

③ Data are separating by commas. Move the cursor using the right and left sides of the Cross-shaped button.

Fig. 12-1 EDIT Mode Screen

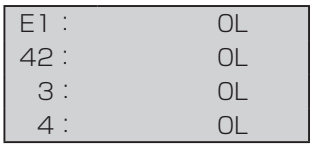


Fig. 12-2 Program Number Selection

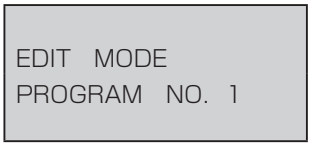
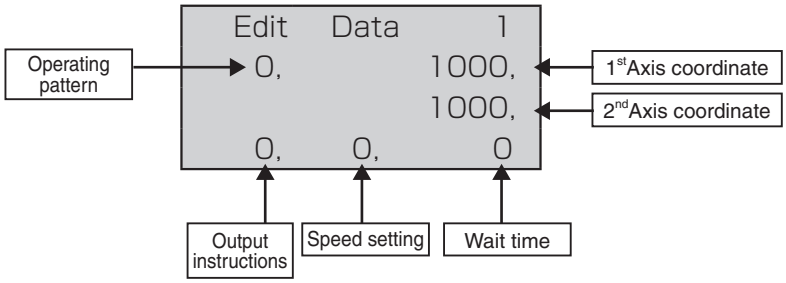


Fig. 12-3 Editing Programs



After moving the cursor to the item you wish to edit, press the "SET" or "SPD" buttons to change the setting for the item.

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④ Press the "MODE" button when entry is complete

The confirmation screen shown in Figure 12-4 will appear display, "(YES: SET) (NO: SPD) (CANCEL: MODE)." Press the "MODE" button to make further changes to position data. Press the "SPD" button to exit without saving position data.

Fig. 12-4 Confirmation Dialog

```
OK ?
YES      → (SET)
NO       → (SPD)
CANCEL   → (MODE)
```

⑤ Press the "SET" button.

Position data will be saved and the initial screen for TEACHING (PROGRAM) mode will be displayed

12-3. Explanation of Program Data

(Table 2) Example of relative positional coordinates entered in Program No. 1

①Line number	②Operating pattern	③First-axis coordinate	④Second-axis coordinate	⑤Output instruction	⑥Speed setting	⑦Wait time
1	0	1234	100	0	1	0
2	0	1000	900	4	3	2
3	0	–500	350	15	4	10
4	99	—	—	—	—	—
|						
8000						

① Line number Programs can consist of from one to eight thousand lines.

② Operating pattern 0: normal operation (move to specified coordinates and stop)

10: continuous operation (specified first axis)

Operate continuously without stopping taking the specified coordinate as a point through which to pass Only one axis may be specified; movement on the second axis stops

(No more than 256 continuous moves should be specified in a row)

※ Set the speed to less than 25 KPPS when trigger output is used

11: Continuous operation (specified second axis)

Operate continuously without stopping taking the specified coordinate as a point through which to pass

Only one axis may be specified; movement on the first axis stops

(No more than 256 continuous moves should be specified in a row)

※ Set the speed to less than 25 KPPS when trigger output is used

20: Two-axis linear-interpolation operation

Move simultaneously to the specified positional coordinates on both axis

Move speed (F) for setting speed.

30: Return to mechanical origin (specified first axis)

Only specified first axis returns to mechanical origin.

Specified second axis is still stopping.

31: Return to mechanical origin (specified second axis)

Only specified second axis returns to mechanical origin.

Specified first axis is still stopping.

32: Return to mechanical origin (specified both axes)

Specified first and second axes return to mechanical origin.

Input the next two operating patterns for the circular interpolation operation.

40: circular interpolation (setting the end-coordinate)

Input the end-coordinate for the circular interpolation operation.

You must input the operating pattern 41 next to the operating pattern 40, otherwise the operation is abnormal operation.

41: circular interpolation (setting the center-coordinate)

Input the center-coordinate for the circular interpolation operation.

You must input the operating pattern 40 before the operating pattern 41, otherwise the

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operation is abnormal operation.

Move speed (S) for setting speed.

(Example)

Line number	Operating pattern	Specified first axis coordinate	Specified second axis coordinate	Output instruction	Speed setting	Wait time
1	40	0	0	—	—	—
2	41	2000	100	1	1	10

Specified first axis -- End coordinate ; 0 pulse (current position), Center coordinate; +2000pulses.

Specified second axis -- End coordinate ; 0 pulse (current position), Center coordinate; +100 pulses.

Moving speed -- 1

After stopping the stages, OUT1 trigger outputs are generated and wait for 1second.

50: Select specified axis (SHOT-304GS)

Select the two driving axes.

Program after this line number 50 drives the specified first axis and the specified second axis.

Line number	Operating pattern	Specified first axis coordinate	Specified second axis coordinate	Output instruction	Speed setting	Wait time
1	50	3	4	—	—	—

Program after this line number 50 operates the specified first axis (stage 3) and the specified second axis (stage 4).

99: End of data

This pattern must be entered in the last line of the program (no operation is performed)

?: Start operation according to specified input conditions

External (four-bit) I/O input signals are monitored and operation is begun under identical conditions

I/O signal conditions can be input to the coordinates for the first axis

(see 0 to 15: "I commands, "page 26)

F: Repeat a block of operations a specified number of times

The number of repeats can be input to the coordinates for the first axis (1 to 255).

N: Marks end of block of operations to be repeated

③ Movement distance on specified first axis

Input the relative distance to be moved (±9999999 pulses)

※If the operating pattern is 30/31/32/99/N, "－" will be input

④ Movement distance on specified second axis

Input the relative distance to be moved (±9999999 pulses)

※If the operating pattern is 30/31/32/99/?/F/N, "－" will be input.

⑤ Output Determine position for I/O or trigger (pulse) output and output signal on completion

[Input ranges] I/O output :0 to 15 (see "O commands, "page 25)

Trigger T (time) : 1 to 10000 (0.01- to 100-seconds interval)

Trigger P (pulses) : 2- to 30000-pulse interval

[Example]

15 :OUT data=15 One trigger output

※If the operating pattern is 30/31/32/40/41/50/99/?/F/N, "－" will be input.

※The following trigger settings can be used when a program is downloaded from a computer:

0P1P10 :OUT data=0 One trigger output for every 10 pulses moved on first axis

※Set the speed to less than 56 KPPS when trigger output is used

2T10 :OUT data=2 Trigger output every 100ms (10ms×10)

4M :OUT data=4 One trigger output

9S :OUT data=9 Trigger output disabled

⑥ Speed Speed settings (S/F/R) stored in memory switches (1 to 4) are input

※If the operating pattern is 30/31/32/40/41/50/99/?/F/N, "－" will be input.

⑦ Wait time Enter wait time (0 to 2560 in units of 0.1 seconds)

※If the operating pattern is 30/31/32/40/41/50/99/?/F/N, "－" will be input.

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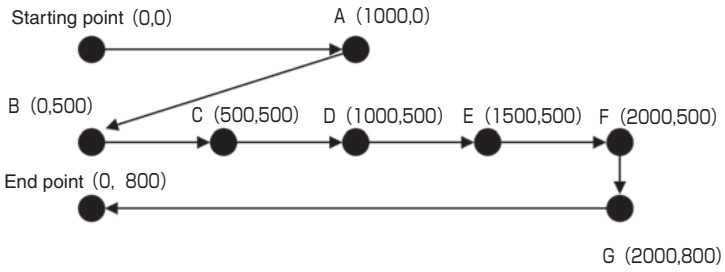
12-4. Example Programs

Examples of simple programs are as follow.

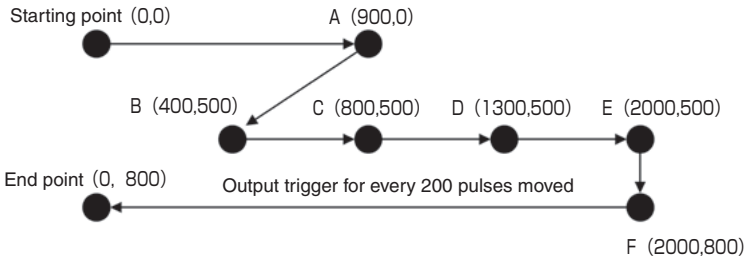
(1) Program Example 1 (edited in EDIT mode)



1. Move to point A at Speed 3. After stopping, output trigger.
2. Move by linear interpolation to point B at the MOVE speed (F) for Speed 4 and stop. After stopping, output OUT=1 and trigger, then wait for 2 seconds.
3. Move 500 pulses on first axis at Speed 4 and stop. After stopping, output trigger and wait for 1 second.This operation is repeated four times.
4. Move to point G at Speed 2 and stop. After stopping, output OUT=2 and trigger.
5. Move to end point at Speed 4. After stopping, output OUT=0 and trigger.

① Line number	② Operating pattern	③ Specified first axis coordinate	④ Specified second axis coordinate	⑤ Output instruction	⑥ Speed setting	⑦ Wait time
1	0	1000	0	0	3	0
2	20	−1000	500	1	4	20
3	F	4	—	—	—	—
4	0	500	0	1	4	10
5	N	—	—	—	—	—
6	0	0	300	2	2	0
7	0	−2000	0	0	4	0
8	99	—	—	—	—	—

(2) Program 2 (downloaded from the computer after editing)



1. Move to point A at Speed 3. After stopping, output OUT=0 (no trigger output).
2. Move by linear interpolation to point B at the MOVE speed (F) for Speed 4 and stop.After stopping, output OUT=1 and trigger, then wait for 2 seconds.
3. Wait until input condition I=1.
4. Move to point E at Speed 4 and stop. After stopping, output trigger output. Output trigger when passing points C and D.
5. Move to point F at Speed 2 and stop.After stopping, output OUT=1 (no trigger output).
6. Move to the end point at Speed 4, outputting a trigger for every 200 pulses moved on the first axis. After stopping, output OUT=2.

① Line number	② Operating pattern	③ Specified first axis coordinate	④ Specified second axis coordinate	⑤ Output instruction	⑥ Speed setting	⑦ Wait time
1	0	900	0	0S	3	0
2	20	− 500	500	1M	4	20
3	?	1	—	—	—	—
4	10	400	—	—	4	—
5	10	500	—	—	4	—
6	10	700	—	—	4	—
7	0	0	300	1S	2	0
8	0	− 2000	0	2P1P200	4	0
9	99	—	—	—	—	—

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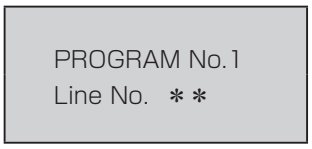
13. Programmed Operation of Motorized Stages

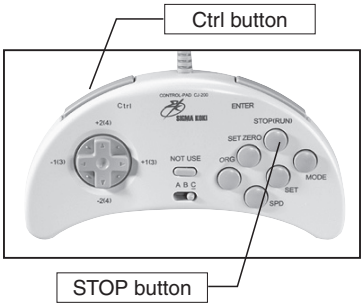
Programs edited in edit mode or downloaded from a computer can be used to operate motorized stages by means of commands received from the computer or by signals from the I/O connectors on the rear panel. There are two programs, No. 1 and No. 2. As end-of-operation signals are output when each operation is completed, programmed operation can be used for easy remote control while confirming the operating condition of each stage. The LCD display during programmed operation shows the program number and the line currently being executed.

Fig. 13-1 LCD Display during program execution



13-1. Starting Programmed Operations from a Control Pad

Pressing the **Ctrl and STOP buttons** simultaneously when no computer or I/O signal is connected will start programmed operation.
Note that the program number is set by I/O signals even during control pad operations.
Program No. 1 is selected when no I/O signals are connected.



13-2. Starting Programmed Operations from a Computer

When starting programmed operations from a computer, you can perform motorized operations (positioning) following the instructions in the program by sending remote (execute) commands from host mode in place of external control signals.
The available commands are shown below.

P:R	Enter program mode
P:H	Return to host mode
P:P[AXIS]	Set program number (1 or 2) [AXIS] 1, 2
P:S	Start independent programmed operation
P:E	Stop independent programmed operation
P:U0	Temporarily suspend independent programmed operation
P:U1	End temporary pause of independent programmed operation
P:C0	Prevent transmission of "operation complete" (COMP) signal when programmed operation completed
P:C1	Allow transmission of "operation complete"(COMP) signal when programmed operation is completed ※The controller will send the data string **"COMP"** when programmed operation is complete
P:T0	Prevent transmission of trigger signal data (TRIG) when trigger is output
P:T1	Allow transmission of trigger signal data (TRIG) when trigger is output ※The controller will send the data string **"TRIG"** when trigger signal is output

13-3. Starting Programmed Operations Using I/O Signals

When starting programmed operations from an external device, you can perform motorized operations following the instructions in the program by turning START input for in I/O signals in the rear control panel ON.
Pauses (PAUSE input signals) and STOPS (STOP input signals) are used to pause motorized operations or for emergency stops.
There are two programs, No. 1 and No. 2, which can be selecting using I/O signals.

Program No.	No.1	No.2
I/O PRG signals	OFF	ON

Motorized stages can be operated (returned to mechanical origin, turned clockwise or counter-clockwise, have their speed settings changed, etc.) by turning I/O connector signals on or off.
End-of-operation signals, output from the I/O connectors when each operation is completed, make it possible to control stages remotely while confirming the operating condition of each stage.

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14. Sending and Receiving Program and Memory Switch Data from a Computer

Program data and memory switch settings can be edited on a computer and downloaded to the controller (SHOT-302GS/304GS), or data can be uploaded to computer and saved to disk.

14-1. Control Pad Operations

1) Record buttons

cross-shaped, up, and down ……①Select program number or memory switch

……②Select UP LOAD or DOWN LOAD

SET ……①In the LOAD mode start-up screen, press this button to upload or download data

……②Press to choose a program number or memory switch

……③Press to upload or download data

MODE ……Press to cancel selection or upload/download (the previous screen will be displayed)

14-2. Example of Upload and Download Operations

This example illustrates how to upload Program No. 1 using the SHOT-304GS.

[Operations]

① From the LOAD mode screen, press the "SET" button.
The selection screen for program number and memory switch settings will appear.

② Press the "top and bottom of the cross-shaped" button until "PROGRAM NO. 1" is displayed. After checking the display, press the "SET" button to display the selection screen for upload and download. If you press the "MODE"button at this point, you will return to the previous screen.

③ Press the "top and bottom of the cross-shaped" button until "UP LOAD" is displayed. After checking the display, press the "SET" button. The display, "(YES: SET)"" (CANCEL: MODE)" will appear. If you press the MODE button at this point, you will return to the previous screen.
Press the "SET"button to upload the data for Program 1 to the computer.

Fig. 14-1 LOAD Mode Screen

```
L1 :          OL
42 :          OL
 3 :          OL
 4 :          OL
```

Fig. 14-2 Program Number Selections

```
LOAD MODE
PROGRAM NO.  1
```

Fig. 14-3 Memory Switch Selections

```
LOAD MODE
MEMORY SWITCH
```

Fig. 14-4 UP LOAD/ DOWN LOAD Selection

```
LOAD MODE
    UP LOAD
```

Fig. 14-5 Confirmation Screen

```
DATA1 UP  LOAD
OK?
(YES       : SET  )
(CANCEL    : MODE)
```

Fig. 14-6 UP LOAD/ DOWN LOAD Selection

```
Saving …
        … OK !
```

14-3. Example of Format for Downloaded Data

(1) Program data

Program data are variable length and are recorded as CSV files (comma separation, CR+LF)

[Example] 1,0,2000,1000,0,1,3 [CR] [LF]
2,0,1000,1000,0,1,2 [CR] [LF]
3,99,3000,1000,3,0,4 [CR] [LF]
[EOF] [EOF] : End of File=1A(H) or Z (ASCII)

(2) Memory switches

All memory switches can be set simultaneously. Commas are used as separators.

[Example] 1, 100, 1000, 200, 500, 5000, 200, …
…1, 1, 10 [EOF] [EOF] : End of File=1A(H) or Z (ASCII)

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14-4. Example of Format for Uploaded Data

(1) Program data

Program data are variable length and are recorded as CSV files (comma separation, CR+LF)

[Example] 1,0,2000,1000,0,1,3 [CR] [LF]
2,0,1000,1000,0,1,2 [CR] [LF]
3,99,3000,1000,3,0,4 [CR] [LF]
[EOF] [EOF] : End of File=1A(H)

(2) Memory switches

All memory switches can be set simultaneously. Commas are used as separators.

[Example] 1, 100, 1000, 200, 500, 5000, 200, …
…1, 1, 10 [EOF] [EOF] : End of File=1A(H)

Download (reference)

1. Preparation and check
   Check that Windows 98, 2000, Me, XP works with Stage Controller using Hyper Terminal.
2. Turn on your computer and Stage Controller.
3. Make a program list that you want to send using Note Pad etc. and save as text.
   〈Example of program list〉
   1,0,10000,0,0,4,0↵ (line no. , operating pattern, coordinate of first axis, coordinate of second axis,
   2,0,-10000,0,0,4,0↵ output specification, set speed, wait time)
   3,99,-,-,-,-,-↵
   z↵
4. Press the "MODE" button on the control pad to switch to LOAD MODE. Press the "SET" button, select the program number you want to download, then press the "SET" button.
5. After you choose "UP LOAD," press the "SET" button. Press the "SET" button again and the screen will display "Receiving..." and the standby screen for download will appear.
6. Start Hyper Terminal on Windows 98, 2000, Me, XP.
7. Select "Transfer of text file" from "Transfer."
8. On "Transfer of text file" screen, select the text file you have saved and click "Open."
9. "Hyper Terminal" screen displays the text file.
10. Press "ctrl" and "z" on the keyboard of the computer.

    At this stage, the program is downloaded from your computer to Stage Controller.

Upload (reference)

1. Start Hyper Terminal on a computer with Windows 98, 2000, Me, XP and set the connection.
2. Press the "MODE" button on the control pad to switch to LOAD MODE. Press the "SET" button, select the program number you want to upload, then press the "SET" button.
3. When the selection screen for "UP LOAD" and "DOWN LOAD" appears, select "UP LOAD" and press the "SET" button twice.
4. Data will be sent to Hyper Terminal.

   At this stage, a program is uploaded from Stage Controller to your computer.

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15. Testing I/O Signal Connections

Test mode is used to monitor input signals from the I/O connector and to test output signals from the I/O connector. Connections to external devices can be checked easily.

15-1. Control Pad Operations

1) Record buttons

cross-shaped, up, and down … ①Select from input signal monitoring or output signal tests
…… ②Select the signals used for I/O tests
SET …… ①In the TEST mode start-up screen, press this button to conduct an I/O test
…… ②Set signals used in output test to OFF (Lo)
SPD …… Set signals used in output test to ON (Hi)
MODE …… Press to cancel selection or I/O test (the previous screen will be displayed)

15-2. Example of Input Signal Monitoring

This example illustrates how to test I/O connector input signals using the SHOT-304GS.

[Operations]

① From the TEST mode screen, press the "SET" button.
The selection screen for input-signal monitoring and output-signal testing will appear.

② Press the "top and bottom of the cross-shaped button" until "INPUT MONITOR" is displayed.
After checking the display, press the "SET" button to display the input-signal monitor screen. If you press the "MODE" button at this point, you will return to the previous screen.

③ Press the "top and bottom of the cross-shaped" button to scroll through the names of the input signals, where you can check the signal level (H/L: OFF/ON) for each signal.
After checking the display, press the "SET" button to display the input-signal monitor screen. If you press the "MODE button at this point, you will return to the previous screen.

Fig. 15-1 TEST Mode Screen

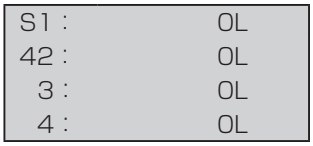


Fig. 15-2 Input Signal Monitor Selection

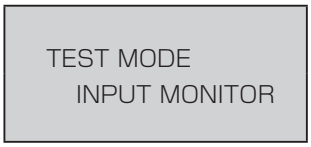
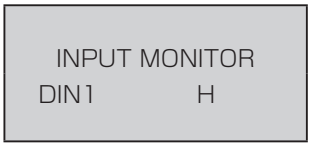


Fig. 15-3 Input Signal Monitor Screen



[Input-signals]

〈Input signal〉	〈Name〉	〈Parameter〉
I/O input	DIN1	H／L
	DIN2	H／L
	DIN3	H／L
	DIN4	H／L
Program number selection	PROG	H／L
Program operation start	START	H／L
Return to first-axis origin	ORIG1	H／L
Return to second-axis origin	ORIG2	H／L
Pause	PAUSE	H／L
Stop	STOP	H／L
First-axis clockwise rotation	JOG1＋	H／L
First-axis counter-clockwise rotation	JOG1－	H／L
Second-axis clockwise rotation	JOG2＋	H／L
Second-axis counter-clockwise rotation	JOG2－	H／L
Speed setting1	SPEED1	H／L
Speed setting2	SPEED2	H／L
Select axis 1, 2/3, 4	AXISSEL	H／L
Alarm reset	ALMRST	H／L

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15-3. Example of Output Signal Testing

This example illustrates how to check I/O connector output signals using the SHOT-304GS.

[Operations]

① From the TEST mode screen, press the "SET" button.
The selection screen for input-signal monitoring and output-signal testing will appear.

② Press the "top and bottom of the cross-shaped button" until "OUTPUT TEST" is displayed. After checking the display, press the "SET" button to display the output-signal test screen. If you press the "MODE" button at this point, you will return to the previous screen.

③ Press the "top and bottom of the cross-shaped button" to scroll through the names of the output signals.
Press the "SET" button to change the output signal to "L (OFF)" or the "SPD" button to set the signal to "H (ON)".
If you press the "MODE" button at this point, you will return to the previous screen.

Fig. 15-4 Output Signal Test Selection

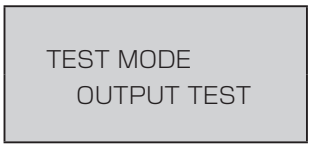
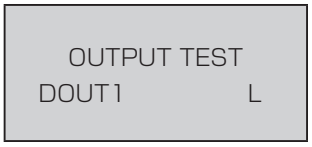


Fig. 15-5 Output Signal Test



[Output-signals]

〈Input signal〉	〈Name〉	〈Parameter〉
I/O output	DOUT1	H／L
	DOUT2	H／L
	DOUT3	H／L
	DOUT4	H／L
Start operation complete	MOVE__C	H／L
Return to first-axis origin completed	ORG__C1	H／L
Return to second-axis origin completed	ORG__C2	H／L
BUSY	BUSY	H／L
Alarm	ALARM	H／L

The control pad is used to set the ON/OFF parameter for output signals.

SET : L (OFF)
SPD : H (ON)

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Chapter 4 : Specification

16. Specification

1) General specifications		
Power source	AC 100-120V/200-240V(±10%) 50/60Hz	
Consumption	160VA(SHOT-302GS)/300VA(SHOT-304GS)	
Operating temperature	5 to 40℃	
Storage temperature	-20 to 60℃	
Altilude	up to 2000m	
Indoor use only		
Installation category	Ⅱ	
Pollution degree	2	
Ambient humidity	20 to 80%RH (no condensation)	
External dimensions	270W x302D x118H (excluding projections)	
Weight	5.5 kg (SHOT-302GS)/6.5 kg (SHOT-304GS)	
(2) Performance		
Controlling axis	2 axis (SHOT-302GS)/4 axis (SHOT-304GS)	
Coordinate display	999999999 pulses	
Maximum driving speed (F)	500kPPS	
Minimum driving speed (S)	1PPS	
Acceleration/deceleration time (R)	0 to 1000ms	
Sensor input	Origin sensor/proximity sensor/CW (-) limit/CCW (+) limit	
	(Memory switches can be used to change input logic for limit sensors.)	
Trigger output	Open-collector output (Maximum use conditions DC24V 30mA)	
Interface	RS232C interface	
	Communication Parameters	
	- Baud rate	38400, 19200, 9600, 4800
	- Data bits	8 bits
	- Parity	None
	- Stop bit	1 bit
	- Flow control	Hardware
	- Delimiters	CR, LF, CR+LF
	GP-IB interface	
	- Setting address	1 to 30
	- Delimiters	CR, LF, CR+LF, EOI
	Universal serial bus (USB) interface	
DC output	DC36V 3.2A (non-isolated) - For motor driver	
	DC24V 1.0A (non-isolated) - external I/O power source Terminal-panel output (motor braking, etc.)	
	DC12V 0.2A (non-isolated) - Sensor power source	
I/O	4 input points (photo-coupler input, internal resistance 2.2 kΩ)	
	4 output points (open-collector output, maximum use conditions DC24V 100mA)	
Control signals	14 input points (photo-coupler input, internal resistance 2.2 kΩ)	
	Program number-1 point/Operating commands-1 point	
	Return-to-origin command-2 points/Pause-1 point/Emergency stop-1 point	
	Rotation-2 points/Reverse rotation-2 points/Speed settings-2 points	
	1, 2/3, 4 axis switch-1 point (compatible with SHOT-304GS)	
	5 output points (open-collector output, maximum use conditions DC24V 20mA)	
	Start operation completed	1 point
	Return-to-origin operation completed	2 points
	BUSY	1 point
	ALARM	1 point
(3) Driver Specifications		
Driver type	bi-polar pentagon micro-steps system	
Driving electric current (output current)	0.25A/phase to 1.4A/phase	
Current down (stop current)	20 to 88% of the specified output current	
Motor excitation	Motor excitation ON/OFF by input signals	
Division (micro-step) settings	1, 2, 4, 5, 8, 10, 20, 25, 40, 50, 80, 100, 125, 200, 250 divisions	
(4) Electrical fast transmit/burst immunity	EN61000-4-4 (2004) Level2	
(5) Electrical isolation voltage	When AC1350V 60Hz is applied between the power terminal and the case for one minute at room temperature and humidity, no abnormality shall occur	
(6) Surge immunity	EN61000-4-5 (2006) Level2	
(7) Electrostatic discharge	EN61000-4-2 (1995)+A1 (1998)+A2(2001) Level2.	

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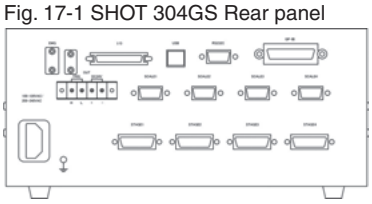
17. Connector Pin Numbers and Signals

Fig. 17-1 SHOT 304GS Rear panel



17-1. I/O Signals

I/O signals are enabled when the controller's operating mode is set to REMOTE mode.

Motorized stages can be operated (returned to mechanical origin, turned clockwise or counter-clockwise, have their speed settings changed, etc.) by turning I/O connector signals on or off from a remote device.

Motorized operations can be performed following the instructions in a controller-internal program using START, PAUSE, and STOP signals. Two programs, No. 1 and No. 2, are available for selection.

As end-of-operation signals are output when each operation is completed, programmed operation can be used for easy remote control while confirming the operating condition of each stage.

17-1-1. I/O Signals for Manual Operation

(1) Description of Input Signals.

・ALMRST input　Reset ALARM (ON WHEN AN ALARM IS RESET TET).

・AXISSEL input　control axis selection (select axis to be controlled axes 1, 2 or 3, 4).
I/O connector allows operation of up to two axes. When the SHOT-304GS (four-axis controller) is used, the axis controlled (1, 2/3, 4) can be selected.

Selected axes	1, 2	3, 4
AXISSEL signal	OFF	ON

・XORG input　Return axis 1 (3) to origin (when ON axis 1 (3) returns to mechanical origin).

・YORG input　Return axis 2 (4) to origin (when ON axis 2 (4) returns to mechanical origin).

・XJOG (+) input　Rotate axis 1 (3) clockwise (axis 1 (3) rotates while signal is on).

・XJOG (-) input　Rotate axis 1 (3) counter-clockwise (axis 1 (3) rotates while signal is on).

・YJOG (+) input　Rotate axis 2 (4) clockwise (axis 2 (4) rotates while signal is on).

・YJOG (-) input　Rotate axis 2 (4) counter-clockwise (axis 2 (4) rotates while signal is on).

・SPEED 1, 2 input　Speed command (stage moves at the speed set in the speed-setting memory switches (SPEED1-4) through combinations of SPEED1 and SPEED2 input signals)

Selected speed	SPEED1	SPEED2	SPEED3	SPEED4
SPEED1 signal	OFF	ON	OFF	ON
SPEED2 signal	OFF	OFF	ON	ON

・IN1～4　Input conditions can be checked as four-bit data

Input	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
IN1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
IN2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
IN3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
IN4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON

(2) Description of Output Signals.

・ALARM output　Alarm (ON when an alarm is generated).

・XORG COMP output　Return-to-origin operation for axis 1 (3) completed (ON when return-to-origin operation for axis 1 (3) is completed)
Signal output as 100ms pulse.

・YORG COMP output　Return-to-origin operation for axis 2 (4) completed (ON when return-to-origin operation for axis 2 (4) is completed)
Signal output as 100ms pulse.

・OUT 1-4　Output as four-bit data

Output	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
IN1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
IN2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
IN3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
IN4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON

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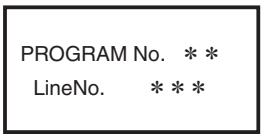
17-1-2. I/O Signals for Motorized Operations

Programmed Motorized operations will start when the I/O signal START input is set to ON.

During operation, the LCD shows the program number and line being executed as (Fig. 17-1).

Fig. 17-2 Motorized Operation Display



(1) Description of Input (Start/Stop) Signals

- PRG input — Program settings (specifies the number of the program data to be executed)

Program No.	No.1	No.2
PRG signal	OFF	ON

- START input — Start command for motorized operations (program execution begins when signal is ON)
- PAUSE input — Pause command (operations are paused while signal is ON, and resume when signal is turned OFF)
- Stop input — Stop command for motorized operations (programmed operations stop when signal is turned ON)
- ALMRST input — Reset the alarm (The error is reset when the signal is turned ON)

(2) Descriptions of Output Signals (while Program Is Running)

- COMP output — program completed (ON when motorized operations are complete)
  Signal output as 100ms pulse
- BUSY output — Busy (ON during operations)
- ALARM output — Alarm (ON when an alarm is generated)

17-1-3. I/O Connector Signals

No.	Name	No.	Name
1	ALARM (H)	26	ALARM (L)
2	BUSY (H)	27	BUSY (L)
3	YORGCOMP (H)	28	YORGCOMP (L)
4	XORGCOMP (H)	29	XORGCOMP (L)
5	COMP (H)	30	COMP (L)
6	ALMRST (H)	31	ALMRST (L)
7	AXIS SEL (H)	32	AXIS SEL (L)
8	SPEED2 (H)	33	SPEED2 (L)
9	SPEED1 (H)	34	SPEED1 (L)
10	YJOG- (H)	35	YJOG- (L)
11	YJOG+ (H)	36	YJOG+ (L)
12	XJOG- (H)	37	XJOG- (L)
13	XJOG+ (H)	38	XJOG+ (L)
14	STOP (H)	39	STOP (L)
15	PAUSE (H)	40	PAUSE (L)
16	YORG (H)	41	YORG (L)
17	XORG (H)	42	XORG (L)
18	START (H)	43	START (L)
19	PRG (H)	44	PRG (L)
20	+V (DC24V)	45	GND (0V)
21	OUT3	46	OUT4
22	OUT1	47	OUT2
23	COM	48	NC
24	IN3	49	IN4
25	IN1	50	IN2

10250-52A2JL Connector (Sumitomo 3M) used

Fig.17-3 I/O Out1～4 Circuit

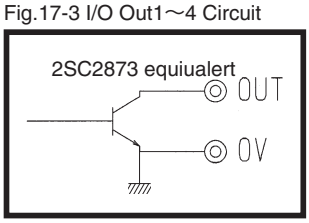


Fig.17-4 Control signal Output Circuit

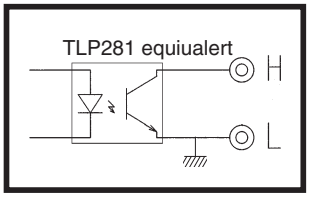


Fig.17-5 Control signal Input Circuit

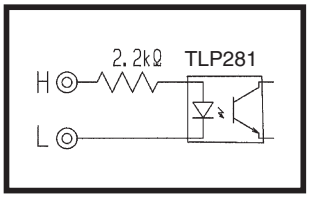
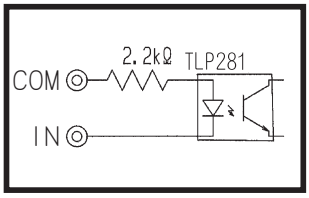


Fig.17-6 I/O IN1～4 Circuit



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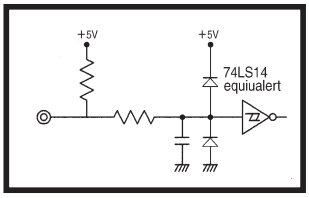
17-2. STAGE1～4 Connector

No.	Name	No.	Name
1	Blue: motor wiring	9	Aconf Auto config
2	Red: motor wiring	10	—
3	Orange: motor wiring	11	LS (+): limit detection on +
4	Green: motor wiring	12	LS (-): limit detection on-
5	Black: motor wiring	13	GND: common sensor
6	GND: common sensor	14	NEAR: proximity detection
7	ORG: mechanical origin detection	15	+12V: sensor power supply
8	+12V: sensor power supply		

Female XM2F-1510 connector (OMRON products) used

Fig.17-7 Sensor Input Circuit



17-3. SCALE1～4 Connector

No.	Name	No.	Name
1	Signal GND	9	Alarm-
2	Signal GND	10	Phase A+
3	+5V	11	Phase A-
4	+5V	12	Phase B+
5	—	13	Phase B-
6	—	14	—
7	—	15	FG
8	—		

XM4L-1542-502 connector (OMRON products) used

17-4. RS232C Connector

No.	Name	No.	Name
1	—	6	DTR
2	TXD	7	CTS
3	RXD	8	RTS
4	DSR	9	—
5	Signal GND		

XM3B-0922-132 connector (OMRON products) used

17-5. USB Connector

No.	Name	No.	Name
1	—	3	DATA+
2	DATA-	4	GND

XM7B-0442 connector (OMRON products) used

17-6. GP-IB Connector

No.	Name	No.	Name
1	DATA1	13	DATA5
2	DATA2	14	DATA6
3	DATA3	15	DATA7
4	DATA4	16	DATA8
5	EOI	17	REN
6	HND (DAV)	18	GND
7	HND (NRFD)	19	GND
8	HND (NDAC)	20	GND
9	IFC	21	GND
10	SRQ	22	GND
11	ATN	23	GND
12	SHIELD	24	GND

57LE-20240-7700D35G connector (DDK products) used

17-7. Control Pad

No.	Name	No.	Name
1	DATA	4	+5V
2	—	5	CLK
3	GND	6	—

TCS7668-01-201 connector (Hosiden Corporation products) used

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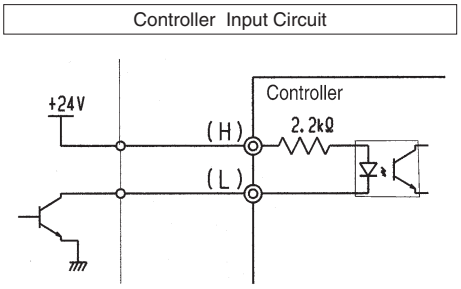
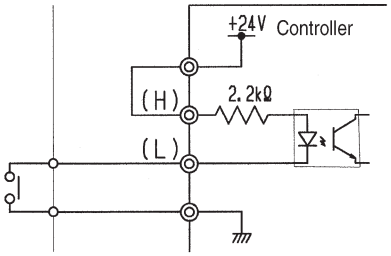
17-8. JOY STICK

No.	Name	No.	Name
1	Signal GND	9	+5V
2	+5V	10	RXD-
3	RXD+	11	TXD-
4	TXD+	12	CONNECT-
5	STOP-	13	—
6	—	14	—
7	—	15	FG
8	Signal GND		

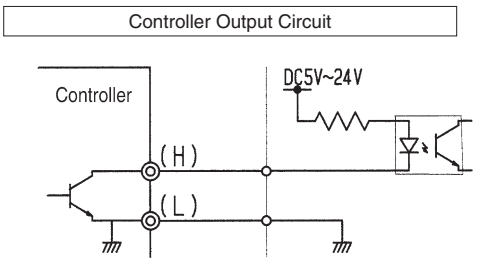
10214-6202PL connector (Sumitomo 3M products) used

17-9. Examples of External Signal Connections





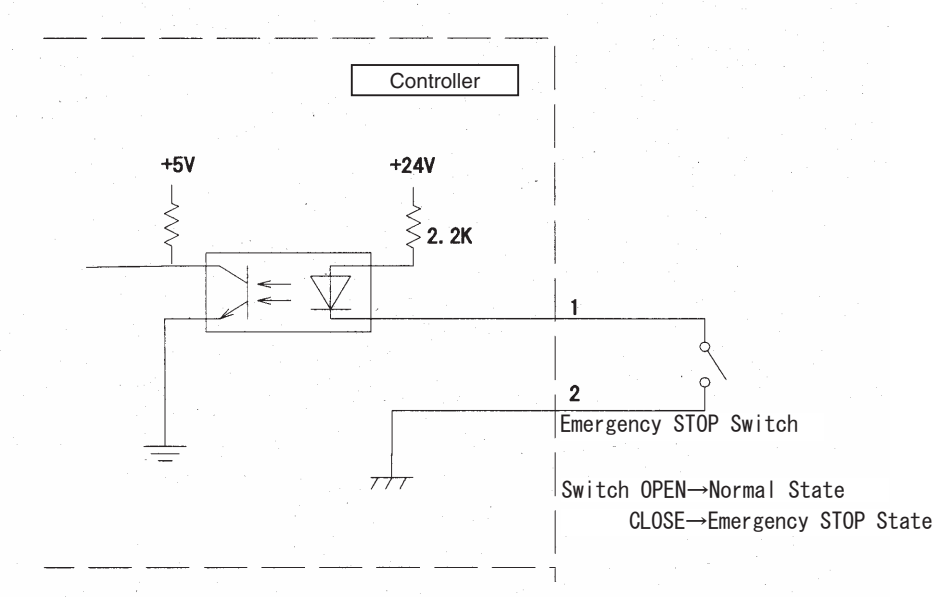
※ Example of connection when controller-internal power source is used.



17-10. Emergency STOP

Connector type S02B-XASS-1 (JST)

In the case of the use, please use Housing XAP-02V-1(JST), Contact SXA-001T-P0.6(JST).



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18. Trigger Signals

Trigger signals are output as pulse wave signals when fixed-length signals from the trigger-signal terminals on the rear panel of the controller ("TRIG") to an external device are set to ON.
The signal output circuit is shown in Figure 18-2.
The trigger-signal pulse width (the length of time the signal is ON) is set in the TRG WIDTH memory switches stored in the controller (three values (lengths) are available).
You can choose the width of pulse from 10μsec, 100μsec, or 1msec.
Trigger signals can be output at specified positions or intervals synchronized with the positioning of an motorized stage. As a result, they can be used to give instructions to an external device during positioning.
Trigger signals can also be output at the completion of motorized stage positioning, allowing instructions to be given to external devices when the stage has reached a specified position.

Fig. 18-1 SHOT-304GS Rear Panel

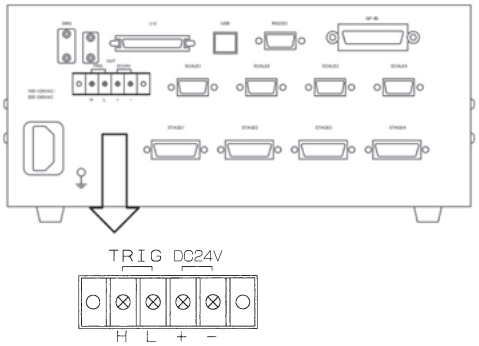
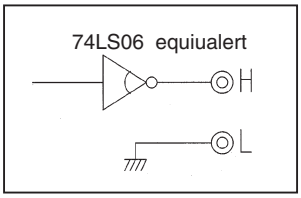


Fig.18-2 Trigger Output Circuit



The following four methods are available for trigger-signal output:

(1) Trigger signals are output once when the ENTER button on the control pad is pressed in MANUAL mode.

(2) Trigger signals are output once when the ENTER button on the control pad is pressed when positioning information is acquired in TEACHING (PROGRAM) mode.

(3) Trigger signals can be output according to control commands from the computer in HOST COMPUTER mode. Use the "T:" command to trigger output by command in HOST COMPUTER mode.

[T command settings]

- Time trigger-output interval : 1 to 10000 (intervals of 0.01 to 100.00 seconds)
- Pulse trigger-output interval : 2 to 30000 pulse intervals

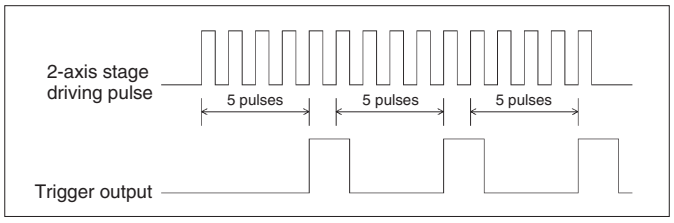
[T command format]

- Set the axis for trigger output and the trigger pulse interval during positioning.

T: P [axis for trigger output] P [trigger pulse interval]

Note: Set the movement speed for motorized stages to less than 56KPPS when using the above commands. (Trigger signals may not output at speeds of over 56KPPS.)

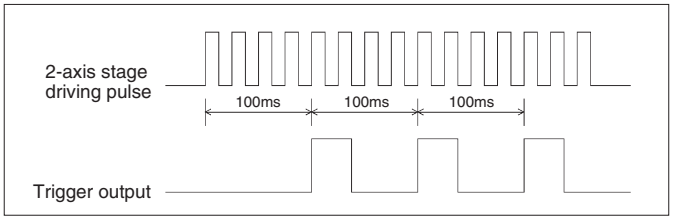
(Example) T: P2P5: Output trigger every 5 pulses when 2-axis stage is in operation.



- Set moving trigger-time intervals of trigger output.

T: T [Trigger output-time intervals]

(Example) T: T10: Output trigger every 100msec (10×0.01 seconds) when 2-axis stage is in operation.



- Output trigger once when the command is executed.

T: M

- Disable trigger output after the command is executed.

T: S

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(4) Output trigger according to program output instructions in REMOTE (EXECUTE) mode.

In program output setting instructions, triggers are output during positioning or when positioning is completed (I/O input settings are made at the same time).

[Output instruction settings]

- I/O output : 0 to 15 (four-bit data output)
- Positioning time trigger output : 1 to 10000 (intervals of 0.01 to 100.00 seconds)
- Positioning pulse trigger output : intervals of 2 to 3000 pulses

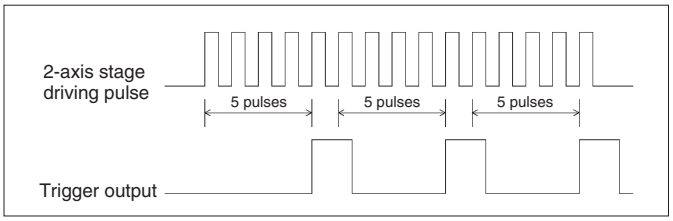
[Format for output instructions]

- Set axis for trigger output and positioning trigger pulses.

[I/O output data] P [axis for trigger output] P [trigger pulses]

Note: Set the movement speed for motorized stages to less than 56KPPS when using the above commands. (Trigger signals may not output at speeds of over 56KPPS.)

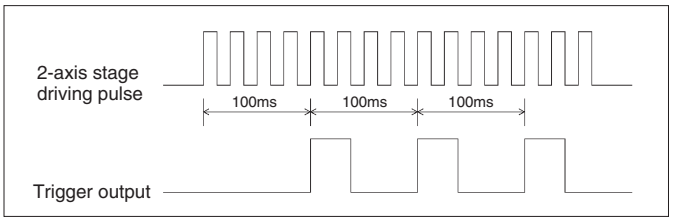
(Example) 0P2P5: I/O output data=0, trigger output every 5 pulses while positioning 2-axis stage.



- Set trigger-time intervals for trigger output during positioning.

[I/O output data] T [trigger time]

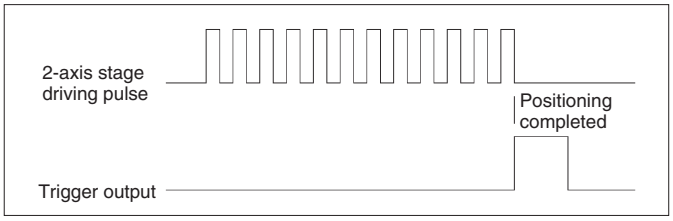
(Example) 2T10: I/O output data=2, trigger output every 100msec (10×0.01 seconds) while positioning 2-axis stage.



- Output trigger once when the command is issued.

[I/O output data] M [M can be omitted]

(Example) 4M: I/O output data=4, trigger output once when positioning of 2-axis stage is completed.



- Disable trigger output after the command is executed.

[I/O output data] S

(Example) 9S: I/O output data=9, disable output trigger.

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Example for Trigger output connection

The open collector gate(74LS06) is used for the trigger output circuit in the controller.In the Figure 18-3, the amplitude of the trigger output pulse is 24V, because of the DC24V power supply connection.

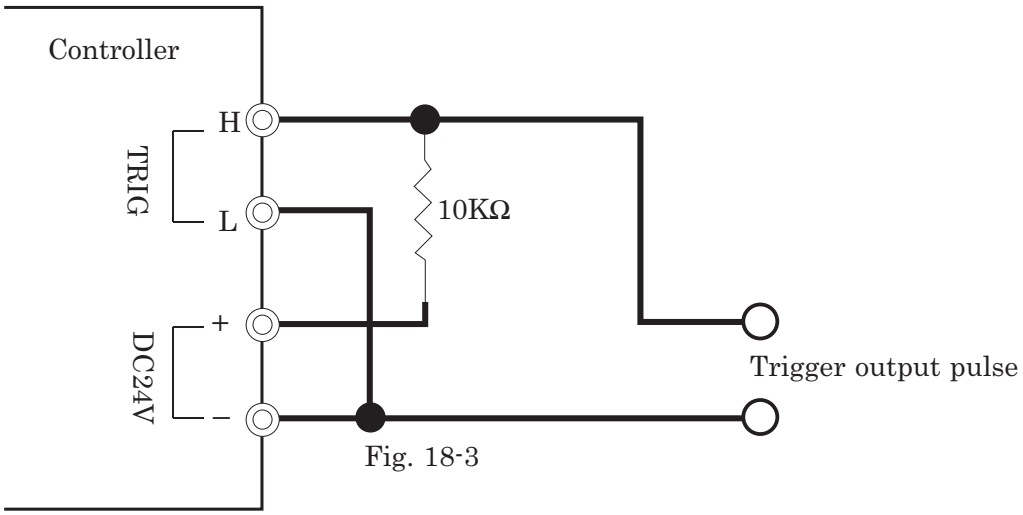

Fig. 18-3

In the Figure 18-4, the amplitude of the trigger output pulse is 5V, because of the +5V power supply connection. In this case, you need to prepare the +5V power supply.

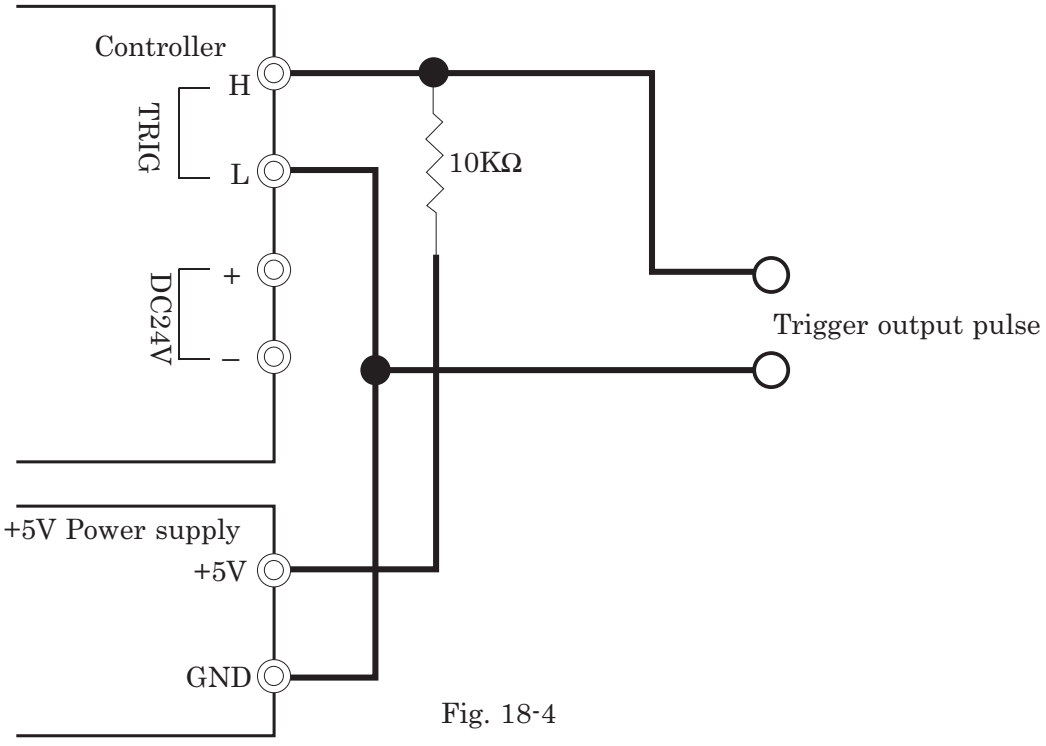

Fig. 18-4

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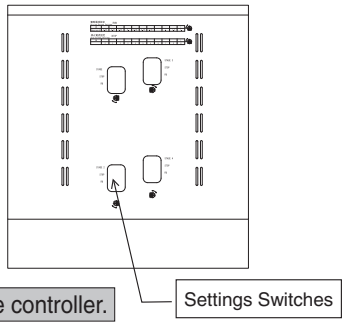
19. Driver Switch Settings

Switches for driver settings (driving current, and stopping current) are found in the base of the controller case.

driving/stop torque of the motors change by settings of each switch.

Fig. 19-1 Base of SHOT-304GS



The number of steps for the drivers is set with "DIVIDE" of the memory switch of the controller.

19-1. Division Settings

If the base step (full step) angle is to 0.72 degrees, the stepping motor makes one full turn every 500 pulses. The motor is said to have a minimum analytic capacity of 0.72 degrees (if the motor moves 1mm for each turn, minimum resolution=1mm ÷500 pulses=2μm).

You can change the minimum resolution by dividing the motor step angle (1/2=0.36°)

Micro-step angles per pulse = Basic step angle (full-step angle)÷number of divisions

Division	1(full)	2(half)	4	5	8	10	20	25	40	50	80	100	125	200	250
Step angle	0.72°	0.36°	0.18°	0.144°	0.09°	0.072°	0.036°	0.0288°	0.018°	0.0141°	0.009°	0.0072°	0.00576°	0.0036°	0.00288°
Number of pulses per full turn	500	1000	2000	2500	4000	5000	10000	12500	20000	25000	40000	50000	62500	100000	125000
Resolution	2μm	1μm	0.5μm	0.4μm	0.25μm	0.2μm	0.1μm	0.08μm	0.05μm	0.04μm	0.025μm	0.02μm	0.016μm	0.01μm	0.008μm

(Example) Set Memory switch to 250 to divide step angle by 250.)

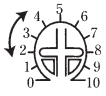
Note 1) If you select the closed loop control, make sure to set the number of steps (DIVIDE) so that the travel/pulse is not more than scale resolution of the stage.

Number of divisions = DIVIDE =BASE RATE (in 0.1μm steps) / 10 x travel per pulse (in μm)

19-2. Driving Current Settings (RUN)

Current settings for motor rotation can be set by adjusting the position of the RUN rotary volume as shown in the following chart.

SW No.	0	1	2	3	4	5	6	7	8	9	10
Amperage(A)	0.25	0.27	0.32	0.5	0.66	0.75	0.86	1	1.1	1.25	1.4



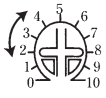
(Example) Set the digital switch to 5 for a motor rated for a current of 0.75 A/phase.

19-3. Stop Current Settings (STOP)

The motor stop amperage can be set by adjusting the position of the STOP rotary volume as shown in the following chart.

The figures in this chart are given as a percentage (%) of the RUN amperage.

SW No.	0	1	2	3	4	5	6	7	8	9	10
%	20	24	27	37	41	51	60	68	75	80	88



(Example) When the digital switch is set to 5 with a motor rated for a current of 1.4A/phase, the motor will be supplied with a current of 0.7A/phase when stopped.

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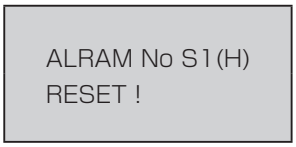
20. Alarm

When an abnormal condition arises, for example, the glass-scale is out of order or a cable is broken, an alarm (out of order) appears with the description of the abnormal condition on the LCD of the controller. (See Fig. 20-1)

Fig. 20-1 Alarm example



When an alarm is generated, first correct the abnormal condition, then clear the alarm as follows:

① Press the "ZERO" button on the control pad.

② Send the reset command (U:) in the HOST (COMPUTER) mode.

③ Turn on the alarm reset signal of the I/O connector signal in the REMOTE (EXECUTE) mode.

If any of the axes is in an alarm (abnormal) condition, the rest of the axes are not allowed to be driven as well.

(1) Types of alarms and causes

When an alarm is generated, check the alarm number that appears on the LCD of the controller to correct the cause of it.

Here is a list of the alarm numbers, nature of the alarms and causes

Alarm No.	Name of alarm	Description	Remarks
00	In order	In order	
S1	Sensor out of order	Generates an alarm when the alarm output of the glass-scale is out of order while being monitored (Abnormal conditions such as broken wires between the detection head and detector).	Scale
S2	Broken wire detected	Generates an alarm when the encoder does not return a signal against the stage slightly moved. (It detects disconnected connectors and others.)	Scale
S3	Control out of order	Generates a warning when the axis does not reach the in-position after the specified number of controls. (It detects malfunction of the driver, inconsistency of the number of steps, and others.)	Scale

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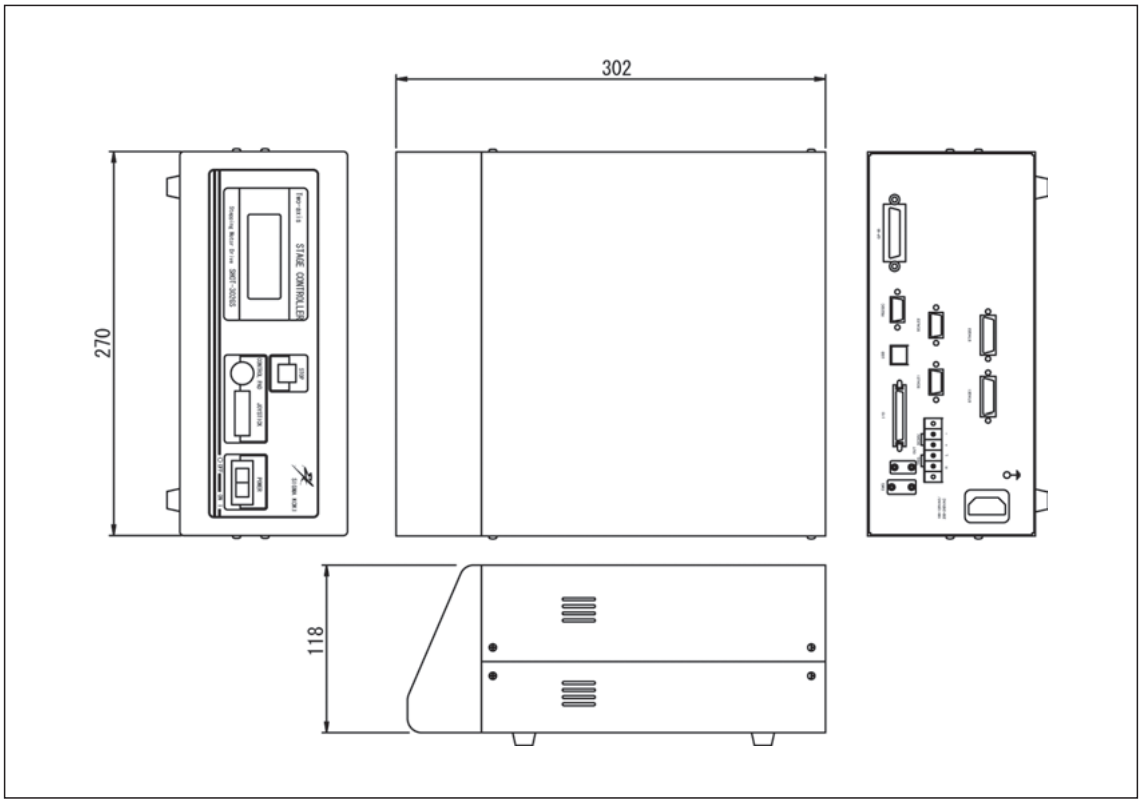
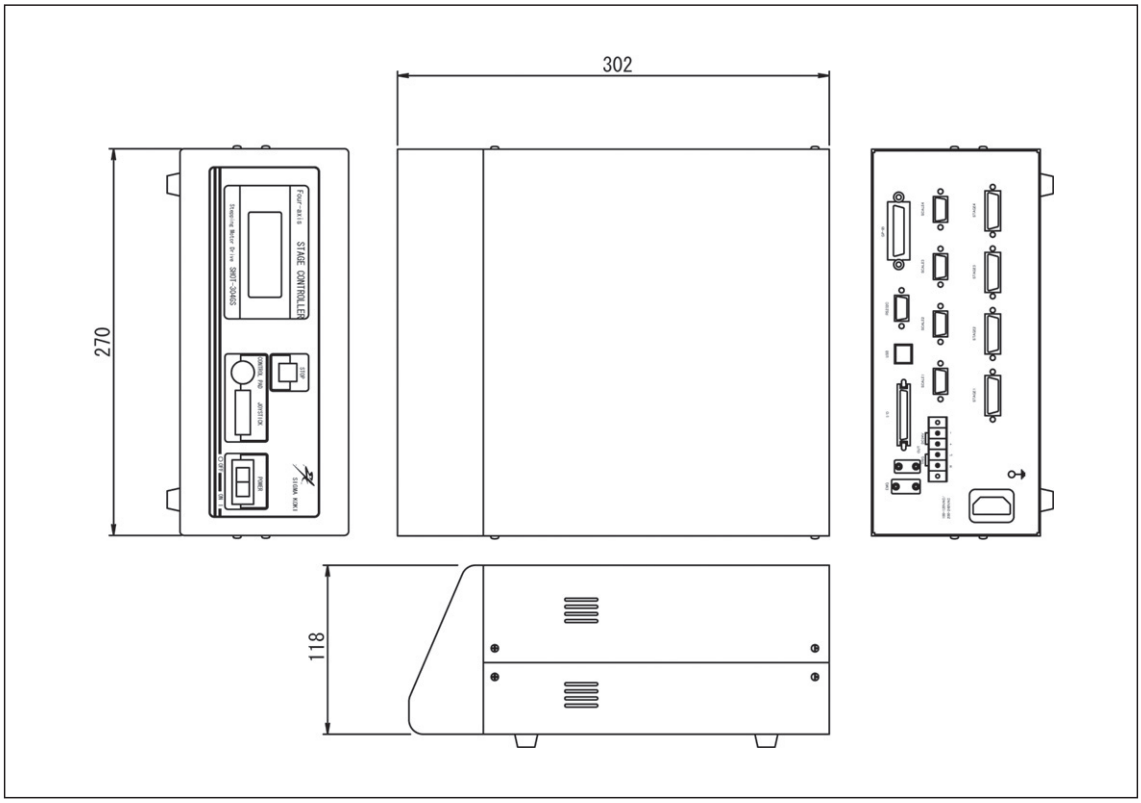
21. Exterior Dimensions

21-1. Exterior of SHOT-302GS



21-2. Exterior of SHOT-304GS



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2014.12. Fourth edition